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This study examined efficiency indicators common within the surgical service management domain. Areas of focus included: the surgical service process, procedural time variations, delays, cancellations and patient satisfaction. Several results involving procedure times were significant. Variation of room turnover time was significant across the services (p = .000). Physician start times also varied significantly (p=.000). Delays occurring in the operating room were examined through a direct observation method. Of the sample (n=779), 17.5 percent of the surgical cases resulted in delays. A chi square analysis examining rates of delays was significant (p less than .05). The majority of root causes for case cancellations were attributed to the patient and surgeon. A sample of 164 surgical patients responded to a patient satisfaction instrument. Significant variation existed across all services (p less than .0001). Similar significance existed when examining variation among the following constructs of the instrument: caring, competence, continuity of care and patient education.

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EXAMINING EFFICIENCY INDICATORS WITHIN THE SURGICAL SERVICE LINE AT EVANS ARMY COMMUNITY HOSPITAL

A GRADUATE MANAGEMENT PROJECT

SUBMITTED TO THE FACULTY OF THE GRADUATE

PROGRAM IN HEALTH CARE ADMINISTRATION

BY

MATTHEW D. KINSER

FORT CARSON, COLORADO

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ABSTRACT

This study examined efficiency indicators common within the surgical service management domain. Areas of focus included: the surgical service process, procedural time variations, delays, cancellations and patient satisfaction. Several results involving procedure times were found to be statistically significant. General surgical and orthopedic cases had higher probabilities associated with longer cases (greater than 90 minutes). Significant variation of room turnover times existed within the nine services ($F_{(8,722)} = 4.59$, $p < .0001$.) Nursing start times were problematic with 54.5 percent of the sample (n = 499) were over 30 minutes late. A chi square analysis yielded insignificant results when examining late nursing starts across the services ($X^2 = 1.63$, $p = .95$). Significant variance did, however, exist when examining physician starts across all services ($F_{(8,3033)} = 43.2$, $p < .0001$). Delays occurring in the operating room were examined through a direct observation method. Of the sample (n = 779), 17.5 percent of the surgical cases resulted in delays. A chi square analysis examining rates of delays across all services was significant ($X^2 = 17.15$, $p < .05$). Variation of minutes wasted by delays, however, proved to be insignificant across the surgical services ($F_{(8,770)} = 1.14$ $p > .05$). Nearly 8 percent of the sample (n = 2,242) used to examine cancellations resulted in canceled elective procedures. The majority of root causes for case cancellations are attributable to the patient and surgeon. A sample of 164 surgical patients responded to a modified Forbes-Brown patient satisfaction instrument. Significant variation existed when examining variation of patient satisfaction across the services ($F_{(4,159)} = 15.37$, $p < .0001$). Similar significance existed when examining variation among the following constructs of the instrument: caring, competence, continuity of care and patient education.

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CHAPTER 1

INTRODUCTION

With the emergence of Tricare, the Department of Defense's managed care plan, military health services managers are beginning to reinvent how diminishing resources are allocated in an era of increasing demand for care. Military Treatment Facility (MTF) commanders must manage very closely their health care dollars to ensure that they are spent wisely and efficiently. Waste and inefficiency become the hobgoblin of the managed care modality for delivering health services.

To be a successful player in this new paradigm for delivering care within the military, MTF commanders must balance the efficient management of their resources while continuing to provide quality services to all enrolled beneficiaries. Competitiveness with the contractor requires cost effectiveness as well as quality of service and no longer will our customers belong to a captured market segment.

One hospital activity certain to attract scrutiny will always be the surgical suite. The process of providing surgical services within a hospital is extremely complex. The very nature of the service breeds inefficiency. The operating room supervisor is constantly faced with the challenge of managing multiple rooms and matching those rooms with the appropriate number of personnel, equipment and supplies necessary to perform a vast number of complicated procedures. For an operating room to run

smoothly, numerous distinct services must interact very closely, often in an environment of competing interests. These services include a variety of surgical specialties, anesthesiology and nursing.

Operating room staff are further challenged with the aspect of serving dual customers, both the surgeon and the patient. The operating room supervisor has an obligation to both. To the patient, the actual consumer of the service, the operating room represents the very essence of modern medicine. The surgeon expects efficient management of the surgical suite which includes scheduling, equipping and supplying individual rooms to facilitate complicated procedures. Satisfying both customers is essential if the service is to continue efficiently and effectively.

Conditions Which Prompted the Study

The surgical suite at Evans Army Community Hospital (EACH) consists of ten operating rooms. Currently, only seven of the operating rooms are staffed to operate, and only five are staffed on any given day. Surgery hours are limited from 0700 to 1500 hours on Monday through Friday and are scheduled in blocks to the various surgical services. These services include general surgery, orthopedic surgery, ophthalmologic surgery, otorhinolaryngology, urology, obstetrics and gynecology, oral surgery, dental services, and podiatry. Recently, the Deputy Commander for Clinical Services (DCCS), who serves as the chief of the medical staff, was concerned about low utilization rates within the operating room. A preliminary study revealed that utilization rates varied by service and by month. However, most surgical services used less than 60 percent of their allotted block times. Table 1 depicts the monthly

utilization rate by service at Evans Army Community Hospital over a five month period during 1995. Block utilization rates fluctuated dramatically during this period, often below the 60 percent level. Regardless of the reason, such low utilization rates are unacceptable. Tremendous resources go into providing surgical services, and any unused blocks of time reflect a squandering of those resources. Some service lines, like podiatry, have a depth of only one provider. When that individual is away, the service will experience a tremendous reduction of operating room utilization.

TABLE 1

BLOCK UTILIZATION RATES BY SERVICE
MAY - SEPTEMBER 1995
EVANS ARMY COMMUNITY HOSPITAL

SERVICE	May	June	July	August	September
Dental Services	35.94%	48.44%	26.67%	23.33%	35.00%
Otorhinolaryngology	72.02%	18.01%	60.47%	26.83%	55.88%
General Surgery	41.52%	58.33%	64.87%	42.82%	68.07%
Urology	52.17%	43.44%	60.19%	54.22%	74.18%
Obstetrics/Gynecology	52.40%	45.57%	55.73%	47.99%	65.34%
Ophthalmology	45.24%	20.24%	39.64%	24.46%	56.52%
Oral Surgery	65.54%	60.34%	31.82%	33.11%	38.79%
Orthopedic Surgery	49.45%	38.93%	47.18%	40.08%	61.32%
Podiatry	16.94%	16.03%	0.00%	23.39%	84.62%

Another point that particularly frustrated the DCCS was the rate of canceled surgical procedures. Typically the hospital report would reflect several cancellations each week resulting in decreased operating room utilization. Currently there is no mechanism to capture data which would reflect the causes of these cancellations.

Statement of the Problem

Low utilization of scheduled block surgical hours in the operating room as well as a steady surgical cancellation rate reflect potential inefficiencies existing within the surgical service line at Evans Army Community Hospital.

Literature Review

Operating room efficiency is well documented in the clinical literature. The predominance of the literature has been produced by nursing professionals which is understandable considering that operating room management is primarily the domain of the nurse. This literature review will examine efficiency with the hospital operating room in the following sequence: operating room scheduling and utilization, procedural timing variations, operating room delays, canceled elective surgeries, and customer satisfaction.

Operating Room Scheduling and Utilization

Scheduling policies and operating room utilization tend to dominate the body of literature concerning the operating room. Current research on scheduling policies greatly utilize earlier simulation studies conducted both manually and with the use of computers. Barnoon and Wolfe (1968) used the Monte Carlo simulation technique to explore the advantages and disadvantages of various scheduling approaches. Utilizing probability distributions, the researchers demonstrated their ability to determine optimal schedules as well as assignments of rooms, nurses, and anesthetists. They

were also able to demonstrate a reduction in staff idle time through their simulation efforts.

Goldman et. al (1969) used a computer simulation model written in FORTRAN IV to determine the efficiency of three separate surgical scheduling policies. The characteristics of a community general hospital were used to guide the simulation model in its study on the first-come-first-served policy, the longest-cases-first policy, and the shortest-cases-first policy. The longest-cases-first scheduling policy demonstrated the highest level of operating room utilization and the lowest paid overtime for the operating room staff. It also demonstrated a high propensity for delayed cases. The shortest-cases-first scheduling policy resulted in the lowest number of delayed cases but also demonstrated low operating room utilization levels. First-come-first served fell into the intermediate range. The researchers felt that the longest-cases-first policy held the most potential in expediting cases through a busy surgical suite.

Schmitz and Kwak (1972) used a manual Monte Carlo simulation model to determine the necessary complement of operating room and recovery room facilities needed when the number of medical-surgical beds are increased by 144 beds. The simulation was designed in order to determine how many more surgical procedures would be performed due to the increase of beds. The researchers wanted to measure what additional operating room/recovery room time and space would be needed as well. Their work provided insight into the number of operating rooms and recovery room beds that would be in use at any one time. They were also able to determine

how long the recovery room would have to remain open in order to meet the increased demand. In a follow-up study, Kuzdrall et. al. (1974) replicated Schmitz and Kwak's earlier work using a computer programming language known as GPSS. Their study was capable of simulating more days than the original study and was useful in that they validated the earlier work. Kuzdrall et. al. came to very similar conclusions.

Computers effectively revolutionized operating room scheduling. Ernst et. al. (1977) developed and implemented software to use in scheduling operating rooms. Their system was capable of sorting requests based on the following parameters: service priority, time, surgeon priority, and the operating room preferred by particular services. The authors noted that systematic approaches to scheduling result in increased satisfaction among the various customers and reduced discord among the operating room personnel.

McQuarrie (1981) provides an in depth, mathematical approach to operating room scheduling in order to determine the "best fit" of available surgical procedures to available operating room time. Utilizing an operations research perspective, McQuarrie focused on previous studies using computer-processors to determine optimal scheduling strategies. He emphasized the difficulties involved with scheduling surgical activities within a hospital as well as the importance of utilizing computers when scheduling the operating room by providing the following scenario:

> If we take a hospital with 10 ORs, in which about 20 operations per day are performed, how many possible schedule sequences are there? A gambler with a mathematical interest would know that the possible combination of sequences of 20 different items would be 20! (20 factorial). This becomes (20 X 19 X 18 X 17 X 16 . . . X 1), which is equal to 2.4329 X 10^{18}. Assuming that a computer could create and check schedule combinations at

1,000,000/s, it would take 77,000 years to find the "single best schedule.

Since it is not yet possible for a computer to examine every possible scheduling possibility, the questions become (1) can one estimate the "theoretical optimum" utilization of the operating room? and (2) what algorithms exist that may assist one in finding "near-optimum" solutions? Due to the permutational complexities of reaching optimal scheduling solutions, McQuarrie suggests that operating rooms be large enough to accommodate all surgical procedures. He also suggests that managers institute shifts in the operating room other than the standard eight hour shift. McQuarrie's description to theoretical bounds for "worst case" and "best case" algorithms led to the estimated utilization rates portrayed in Figure 1.

Utilization Rates	Description
100%	Absolute optimum, not realistically obtainable on a regular basis
80-95%	Exceptional performance based on maximal effort & longer scheduling period
70-80%	Good scheduling algorithm
60-70%	Acceptable scheduling algorithm
50%	Worst-case schedule allocation
below	
	Poor management, unacceptable

Fig. 1. Estimated judgmental utilization rate based on McQuarrie's models.

Mathis (1982) and Shukla et. al. (1990) outline the uses of data base software to capture procedure duration time in order to enhance scheduling. Mathis' technique also provides instant information to such key areas as Central Supplies, various clinics, nursing and recovery rooms. He further provides anecdotal information pertaining to increased productivity in the operating room and other satellite services. Shukla et. al.

found that data base processes were more efficient at predicting case lengths than estimates from surgeons themselves. The researchers hypothesized that the introduction of certain data base scheduling models would improve operating room efficiency by avoiding overbooking and/or underbooking the rooms. They felt that this could be accomplished by effectively predicting procedural case lengths using four data base models. The models used to predict case lengths were: (1) Data-Based Estimation by Procedure, a model using the median case time but not considering individual surgeons or case complexity, (2) Data-Based Estimation by Procedure and Surgeon, a surgeon specific model, (3) Data-Based Estimation by Case Complexity of Procedure, a model breaking procedures into three categories of simple, average or complex, (4) Data-Based Estimation by Procedure, Case Complexity and Surgeon, the most complex of the models combining the properties of the last two. Their null hypothesis, or no difference model, suggested that surgical blocks could be effectively scheduled subjectively using the surgeon's own estimates for case length. The researchers found that each model performed significantly better than the subjective model in terms of over/underbooking the operating room ($\alpha = .05$). The model using data-based estimations on procedure, case complexity and surgeon outscored all other models in terms of efficiency.

Computers have also been used in designing surgical suites within hospitals. Zilm et. al. (1976) compiled historical data involving daily surgical caseload, types of procedures, seasonal variation, and the occupancy rates of operating rooms and recovery rooms. Using a computer simulation model, the researchers succeeded in

simulating a 100 day period of varying surgical demand in order to define the optimal number of operating rooms for their new facility.

In a similar study, Hackey et. al. (1984) utilized a combined probability distribution to allocate block time to surgeons. After examining 950 surgical cases, Hackey et. al. constructed a frequency distribution placing surgical procedures into various classes which were assigned by case lengths. They defined short cases as those taking 89 or fewer minutes to complete. By examining the frequency and probability of the defined short cases, the researchers determined that 25 percent of the available block time would effectively satisfy that caseload. They concluded that a combination of block scheduling and longest-time-first scheduling would best fit their needs; therefore, the last 25 percent of each blocked day would be best dedicated to the shorter cases.

Breslawski and Hamilton (1991) examined the multiple criteria involved with operating room scheduling to argue which scheduling policies best serve which organizational goals. Organizational goals studied included: (1) effectively use the operating room suite, (2) satisfy surgeons, (3) satisfy patients, (4) satisfy operating room staff, (5) achieve simplicity and ease of scheduling, (6) effectively use the post anesthesia care unit (PACU), and (7) achieve a low cancellation rate. They utilized a number of simulation studies to evaluate each policy and designed a matrix to demonstrate which policies supported the above mentioned goals most effectively. The published matrix provides administrators with a tool to better determine which policies best support the goals of their own organizations.

Another study by the same researchers, Hamilton and Breslawski (1994), assembled a panel of 38 experts (operating room directors) from across the nation to participate in a Delphi study. Their purpose was to create a generic operating room scheduling model that best fit the needs of today's technologically advanced surgical suites. They were able to construct 39 factors considered absolutely essential by the expert panel when constructing a scheduling model. From this information, Hamilton and Breslawski were able to create a useful scheduling model. The model consisted of three distinct types of knowledge necessary for implementation: core knowledge, semicore knowledge, and local knowledge. Core knowledge was defined as that which must be known at every implementation site. Examples of core knowledge are the estimated surgical case length by surgeon and the number of operating rooms available for the purpose of scheduling. Semicore knowledge was defined by the research team as being efficient with the factors associated with block scheduling and first-come-first-served scheduling policies. Local knowledge was defined as those factors only relevant to individual organizations (e.g., room size, room restrictions, room assignments by specialty). The model was tested for validity by implementing it in three separate facilities, one of which did not take part in the Delphi panel. The research team provides the reader with anecdotal evidence of success.

Procedural Timing Variations

Certainly operating room scheduling relies heavily on case lengths, start times and room turnover. The body of literature contains several studies pertaining to this very element of scheduling. Goldman et. al. (1970) produced a model to examine the

ratio of estimated surgery time to the actual duration of the procedure. They depicted a functional relationship between this ratio and operating room utilization. As variability increased between estimated and actual surgical times, utilization rates within the operating room decreased ($p < .01$). A similar study conducted by Magerlin and Martin (1978) determined that a causal relationship existed between accurate estimations of surgical procedure lengths and effective operating room scheduling. By reducing the variance of the daily operating room workload, managers can positively affect utilization. They can accomplish this through the reduction of idle time of staff members, cancellations and overtime.

Maintaining data on procedure lengths by surgeon to construct case length profiles was the basis for an application constructed by Priest et. al. (1980). The researchers concluded that efficient scheduling of the operating room could be realized by maintaining a running log of case lengths by procedure and surgeon. Priest et. al. suggested that scheduling operating room time by the average length of the case would reduce delays and enhance utilization.

Pirnke (1989) devised a study to examine deviations from the forecasted operating schedule. Her research questions were concerned with the direction of variance and if specific categories of surgical procedures experienced greater discrepancies than other procedures. She conducted a retrospective study within two Washington state hospitals examining 240 surgical cases. Of the 240 cases, 13 (5.4 percent) cases matched exactly between the projected and actual case lengths. Procedural case length was underestimated in 62.4 percent and overestimated in 30.4

percent of the cases. Orthopedic and gynecological procedures experienced the highest number of discrepancies accounting for 30 percent of all the cases. Plastic surgery and urology experienced the lowest number of procedural discrepancies. Oddly, the less complex surgical cases demonstrated the greatest variance between scheduled and actual case length. Pirnke hypothesized that surgeons involved with the more difficult procedures were more aware of their time requirements due to the degree of uncertainty involved.

Bross et. al. (1995) also examined scheduled procedure lengths and compared those to the actual procedure lengths. They found that 72 percent of the procedures investigated experienced at least 15 minutes variance. The procedures with the greatest propensity for variance were orthopedic and neurosurgical procedures. The least variance occurred for colorectal, gastroenterological and podiatric procedures.

Bross et. al. (1995) also scrutinized operating room start times. They discovered that 22 percent of the scheduled cases did not start on time. Bross et. al. were able to correlate postponed starts to a variety of delays. Mazzei (1994) also examined surgical case start times. Dr. Mazzei examined the first cases of the day at a university medical center for a six month period. He was able to analyze a sample of 5,043 surgical cases during this period. An analysis of the scheduled start with the time a patient actually entered the room varied significantly among the surgical services ($p < .05$). First incisions varied from 21 to 49 minutes after the patient was brought into the operating room. Mazzei's study clearly revealed that operating room

start times for the first scheduled cases possessed significant variation. Either the room was not ready due to late set up or the patient was not ready.

Another predominant theme in the clinical literature pertaining to operating time involves turnover. Schanilec et. al. (1993) conducted a two year analysis of 29 facilities to determine an acceptable benchmark for operating room turnover time. Each facility participated in detailed concurrent utilization studies involving over 4000 surgical cases. Their study took into account the type of facility, annual surgical volume, the number of operating rooms, and hospital bed size. Results indicated that turnover was significantly shorter within ambulatory settings with a range of 12 to 18 minutes. Turnover within a traditional hospital setting ranged from 15 to 32 minutes. Upon further review of the data, Schanilec and Reynolds (1994) found that turnover time varied significantly among various surgical specialties as well as by facility type. They determined that the absence of support systems (e.g., case carts, turnover teams) impact turnover time tremendously. Oddly enough, Rickets et. al. (1994) found that turnover time was significantly shorter in duration when the consultant surgeon was present at the surgery ($p = .0022$). Mazzei (1994) discovered uniform turnover rates of 36 minutes for all surgical services with the exception of ophthalmology which was significantly shorter. Mazzei theorized that this was due to the fact that the floors did not require mopping between ophthalmologic cases. Orthopedic and Neurosurgical cases were significantly longer than 36 minutes primarily due to extended room preparation times.

Operating Room Delays

Although time variations hinder efficient utilization with the operating room, case delays can become troublesome as well. The operating room provides a rich environment for delays to occur. Andree (1988) surveyed 161 hospitals and discovered that causes for surgical delays were fairly universal with "tardiness of the surgeon" being the most prevalent at 30 percent. This was supported by Robinson (1993) who constructed a data collection system to measure delays occurring in the surgical suite during a one year period. The two most common causes for surgical delays were "surgeon not present at scheduled start" and "preceding case ran long." The study by Bross et. al. (1995) confirmed these previous findings. In their exercise, most of the delays (84 percent) occurred due to surgeon delays, prior case overruns, anesthesia care provider delay, and patients arriving late to the operating room.

Grudich (1991) surveyed surgeons and anesthesiologists to determine what they considered as the most frequent sources for delays occurring in the operating room. Grudich found that they considered delays caused by prior cases, the patient not being ready, and anesthesia induction as the most common culprits. After analyzing 176 surgical cases, Grudich discovered that 157 cases (89 percent) experienced delays of more that 5 minutes. The most frequent cause for the observed delays was the surgeon showing up late for the case which accounted for 50 percent of the observed delays. Lateness of the anesthesiologist accounted for 15 percent of the delays. Equipment failures accounted for 12 percent of the delays. Operating room staff not being ready accounted for 8 percent of the delays. Interestingly enough,

previous cases going longer than anticipated accounted for only 5 percent of the observed delays.

Weimer (1993) analyzed sequential work activities (SWAs) identified as critical to the timely progression of surgical cases within the operating room. SWAs were delineated by specialty groups such as anesthesia, surgeon and nurse activities. Once identified, Weimer established time standards for the SWAs. She then used direct observation as the method for collecting data pertaining to factors causing delays for each SWA. Weimer created an excellent data collection tool to capture delays occurring in the operating room. Although she did not publish results of her study, her methodology for data gathering is quite interesting.

Rickets et. al. (1994) conducted a study on operating room utilization within three British hospitals. They focused on elective orthopedic surgical procedures and found that 60 percent of the available operating time was used to actually perform surgery. Turnover time took 21 percent of the available time, and no useful activity occurred at all during the remaining 19 percent of the time. They discovered an average start delay of 26.5 minutes. Only 9 procedures (6 percent) started within 5 minutes of the scheduled start. The anesthetic staff were assigned blame for 63 percent of the delays occurring in the operating rooms. The operating room staff were responsible for 24 percent of the delays. Unlike previous studies, surgeons accounted for only 10 percent of the delays.

Canceled Elective Surgeries

Another factor effecting utilization rates in the operating room is canceled elective surgeries. Knight (1987) conducted a one year concurrent review of surgical cancellations at Johns Hopkins Hospital. Of 3,302 surgical patients presenting at Johns Hopkins, 605 (15 percent) canceled after a preoperative evaluation. Medical illness accounted for most of the cancellations. Of adults who canceled, 49 percent canceled because of a medical illness while 56 percent of the children canceled due to a medical illness. The predominant medical illnesses among adults included cardiac problems, hypertension, abnormal laboratory test results and upper respiratory infections. Among children, 82 percent of their medical illnesses was due to upper respiratory infections and other infections. Changes in the surgeon's plans or changes in the patient/parent's plans accounted for the bulk of the remaining cancellations. Other causes for surgical cancellations occurred because of a violation of the physicians preoperative orders, insurance problems and poor weather conditions preventing travel to the hospital. Knight hypothesized that cancellation rates could be reduced significantly if surgeons completed a brief history and physical examination focusing on cardiac symptoms and blood pressure before scheduling the surgery.

Thompson (1991) performed a 12 month prospective audit of canceled oral and maxillofacial surgical procedures at the University of Manchester. He found that 31 percent of the scheduled surgical procedures were canceled. Of 263 canceled operations, 45 percent were canceled by the university hospital because of bed shortages and nursing staff shortages. Thirty-one percent were canceled by the

patient. Reasons for this included medical conditions such as respiratory tract infections as well as domestic influences such as family and work conflicts. Twenty-four percent of the cancellations occurred because the patient did not present for surgery at all.

Hand et. al. (1990) reviewed 4100 procedures over a six month period and found a cancellation rate of 13 percent for outpatient procedures, 9 percent for same day surgery procedures, and 17 percent for scheduled inpatient procedures. They determined that dental procedures had a significantly higher cancellation rate among outpatient procedures while cardiovascular surgical procedures experienced significantly higher cancellation rates among inpatient procedures. A retrospective review of inpatient cancellations revealed that 43 percent of those were due to administrative errors, unsigned consent forms being the most common. Medical factors contributed to the remaining cancellations with reevaluation of surgical condition and associated medical illness being equally prevalent as the top cause.

Lacqua and Evans (1994) reviewed 1,063 scheduled surgical cases in which 184 (17 percent) were canceled. They found that urological cases were significantly more likely to be canceled among the outpatient procedures than orthopedic and pediatric surgery. They also found that plastic surgery procedures were significantly more probable to be canceled than among orthopedic and obstetrics and gynecological procedures among inpatient cases. Lacqua and Evans determined that lack of medical clearance and outpatient "no shows" accounted for most of the avoidable cancellations. They concluded that cancellations could be avoided by improving the

patient evaluation process as well as the communication process between the physician and patient. Much of the patient evaluation process was determined to be the actual effort to complete effective histories and physical examinations on each patient. The communication process primarily involved interpersonal activities between the patient and the physician.

Customer Satisfaction

Although an indicator of efficiency, very little has been written about customer satisfaction involving operating room services. Holland et. al. (1995) contributed greatly to the field of patient satisfaction by measuring the determinants of satisfaction for outpatient surgery patients. They utilized a critical incident approach to develop their instrument in order to preserve content validity. They developed six constructs based on this approach: (1) Facility Environment, (2) Courtesy and Sensitivity, (3) Facility Efficiency, (4) Information and Education, (5) Clinical Quality and Safety, and (6) Physical Privacy. They assessed each construct using an equal number of positively and negatively worded items that were measured by a five-point Likert scale. Using multiple regression analysis from a sample of 257 patients, they determined that Courtesy and Sensitivity and Clinical Quality and Safety were the most powerful predictors of overall satisfaction ($p < .001$).

The increase in ambulatory surgery has spurred an interest in perceived satisfaction among ambulatory surgical patients. Forbes and Brown (1995) utilized a modified Delphi technique to develop a satisfaction questionnaire focused entirely on surgical patients, both inpatient and outpatient. Their efforts culminated in a survey

comprised of four constructs: caring, continuity of care, provider competency and patient education. No findings were reported.

Pica-Furey (1993) found that surgical patients were more satisfied with care received in a freestanding ambulatory surgical center than at a hospital-based ambulatory surgical care center. Utilizing a sample of 85 patients (44 from the freestanding center and 41 from the hospital-based center) Pica-Furey found statistically significant differences existing among the following domains: structure, convenience of access, courtesy of ancillary staff, cost, and ease of initiating complaints about the services. In each domain, patients were more satisfied within the freestanding ambulatory surgical care center. Although not significant, Pica-Furey found that patients within the freestanding center were more satisfied with the technical expertise demonstrated by their providers, the level of interpersonal communication existing between patient and provider, and the educational instruction received from providers and staff.

Patient satisfaction within the Military Health Service System was examined by Mangelsdorff (1994) utilizing a modified instrument produced by the Group Health Association of America. Mangelsdorff concluded that eligible beneficiaries of military health care are moderately satisfied with the level of care they received. They are least satisfied with 1) their inability to choose a specific provider, 2) phone access, 3) the number of doctors to choose from, 5) the inordinate length of time between making the appointment and presenting for that appointment and 6) access via the telephonic appointment system. Patients were most satisfied with the level of interpersonal care

they receive, the technical quality of services rendered and the low financial burden of military health care. Mangelsdorff further concluded that retired beneficiaries were more satisfied overall with military health care while active duty spouses were the least satisfied.

Doyle and Ware (1977) conducted a study in 1974 with a sample of 432 adults to determine factors leading to satisfaction among adult medicine patients. They examined six dimensions of care: Physician Conduct, Continuity of Care, Accessibility, Availability of Hospitals and Specialists, Completeness of Facilities, and the Availability of Family Doctors. Each dimension proved to be a statistically significant factor ($p < .01$) capable of predicting the level of satisfaction perceived by an adult medicine patient with the exception of Availability of Hospitals and Specialists. Physician Conduct was the most notable factor accounting for approximately 41 percent ($r^2 = .414$) of the variance. This dimension dealt primarily with patient perceptions regarding technical expertise and the interpersonal arts of the provider. Doyle and Ware concluded that substantial opportunities exist to increase patient satisfaction by focusing on patient-physician relationships.

One of the reasons for examining patient satisfaction is to prevent certain patient behavior which has been defined by health care professionals as negative. Ware and Davies (1983) examined three such behaviors and their links to overall satisfaction with health services. The first behavior, care seeking, explores whether a patient will seek appointments during illness episodes or regular wellness appointments when deemed necessary. The second behavior, adherence, examines whether patients

are inclined to "do the things they are supposed to do while under care." This includes lifestyle changes affecting diet, smoking, exercise, and alcohol consumption. The third behavior examined by Ware and Davies involved certain "reactive" manners. This includes such things as recommendations in favor of certain providers, hospitals, and health plans. It also dealt with the propensity to initiate complaints and malpractice suits. Their findings were significant. Ware and Davies discovered that relatively minute changes in patient satisfaction can result in notable alterations in patient behaviors. Satisfaction levels proved to be significant predictors relating to changes in doctors and pre-paid health plans.

Purpose

The purpose of this study is to examine the underlying variables identified in the literature review that may contribute to inefficiencies within the surgical service line at Evans Army Community Hospital. This will be accomplished through a series of studies using techniques revealed through the literature review. Once identified, recommendations pertaining to individual inefficiencies will be formed.

CHAPTER 2

METHOD AND PROCEDURES

One of the purposes for the literature review was to determine areas which may lead to potential inefficiencies within the surgical service line. Once identified, these key areas may be scrutinized. From the literature review, a study design was developed. Figure 2 depicts this study design.

The literature suggests that inefficiencies may develop from at least five measurable indicators. This study will primarily consist of those five main areas: 1) The Surgical Service Process, 2) Procedural Timing Variations, 3) Delays Occurring in the Operating Room, 4) Surgical Case Cancellations, and 5) Surgical Patient Satisfaction.

Due to the inordinate amount of data used for this study, certain ethical boundaries existed. Data pertaining to surgical cases was stored in the scheduling software, Surgi-Server™. This information, although not public, was supplied for the purpose of this research. Great lengths were taken to protect the identities of surgical patients. Individual cases were not examined but rather the aggregate using both descriptive and inferential statistical analysis. At no time did individual patient information become compromised.

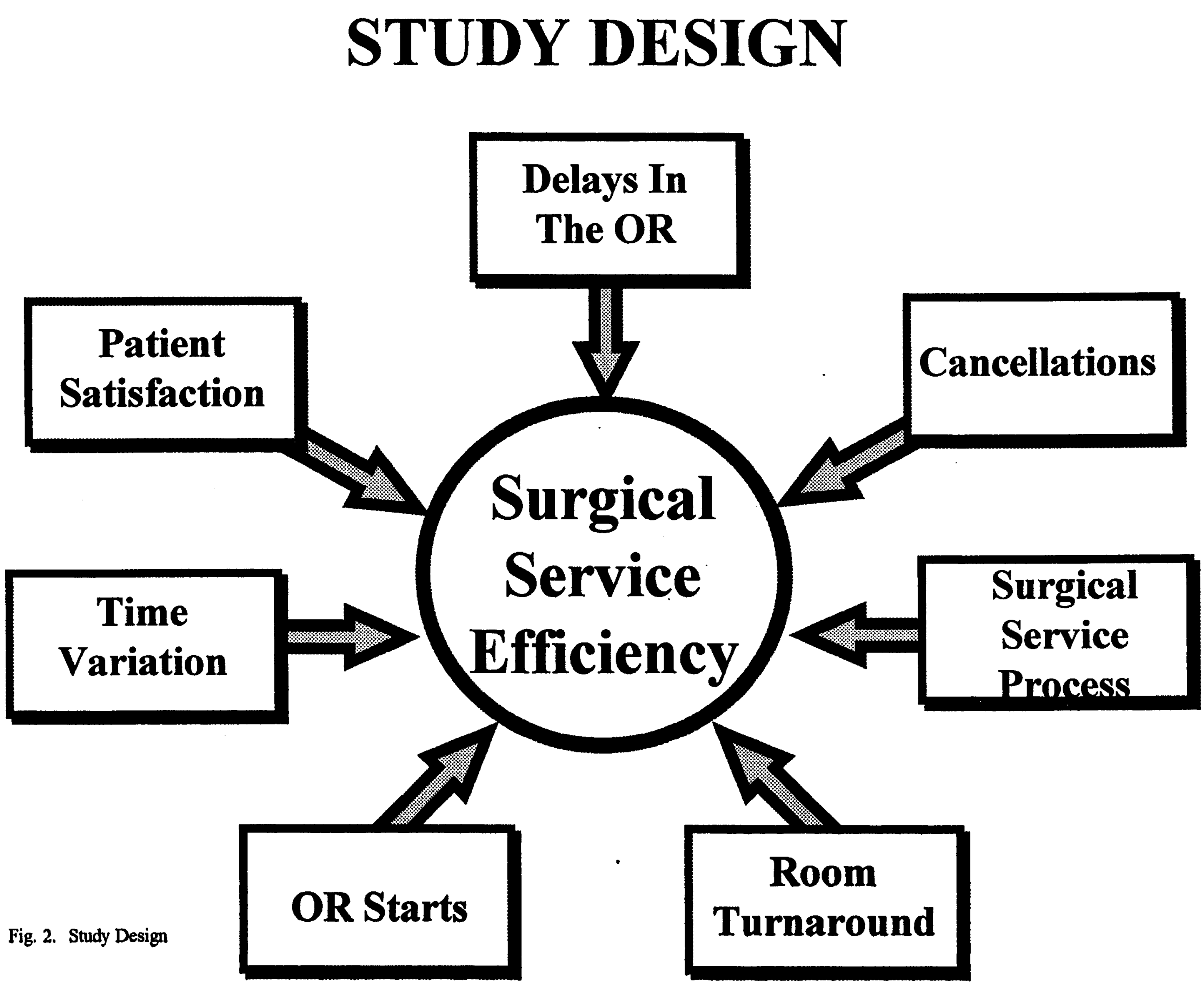

Fig. 2. Study Design

The Surgical Service Process

When studying a process as complicated as surgical services within a hospital, one should strive to understand the process as thoroughly as possible. To gain this understanding, expert knowledge was utilized through a variety of interviews. The General Surgery Clinic at Evans Army Community Hospital was used as a benchmark for mapping the processes of both providers and patients as they move both collectively and individually through the surgical service process. Hospital staff members from the General Surgery Clinic, Patient Administration Service, Third Party Collections, Same Day Surgery, the Operating Room, and the Post Anesthesia Care Unit (PACU) were interviewed to gain their perspectives on the process. In order to measure elapsed time within the process as well as capture the complexities involved with delivering surgical services to patients, the Program Evaluation and Review Technique (PERT) was used. PERT was developed in the late 1950s by the Navy Special Projects Office as a tool to be used in the planning and controlling of the Polaris missile program. Faced with completing the project within a very short period of time, the U. S. Navy assembled a team of experts to develop a technique to control and coordinate all activities (Moder et al. 1983).

The Basic Steps for Using PERT Analysis

1. Determine the major activities of importance within the surgical service process. For the purpose of this study, activities were divided into "provider activities" and "patient activities." Each activity is assigned a letter designation for the purpose of establishing an easy reference.

2. Determine the time sequencing of the major activities. Once again, expert opinion was used to gain insight on the sequence of activities. This is an important step because it allows the reader a visual map of the activities. If each activity had to be completed before the next one began, the activity list could be used to construct a straight line activity network. This is not usually the case, however. Within the surgical service process, some activities are carried out simultaneously, while others cannot begin until a prerequisite task has been completed.

3. Estimate the length of time which will be required for each activity. Staff members were asked to provide their opinion about the length of time required for various steps within the process. They were asked to assess each activity for the most optimistic time (symbolized as a), the most pessimistic time (symbolized as b) and the most likely time (symbolized as m).

4. Calculate the Expected Time (symbolized as t) for each activity. The originators of PERT developed a beta distribution for the above three estimates. This allowed for the calculation of a combined time value (Levin et al. 1992). They accomplished this by using the following weighted average formula where t equals that time value, the "expected time."

$$t = \frac{a + 4m + b}{6}$$

5. Calculate the variance of each activity. This step is necessary to provide managers and planners with information regarding the degree of certainty of the Expected Time (t) calculated in Step 4. The variance of activity time simply reflects the difference between the "most optimistic" and "most pessimistic" times. The more

they agree, the lower the variance will be. Variance in activity time is calculated by using the formula $[b - a/6]^2$.

6. Construct the "Surgical Service" Network. The network, according to Levin et al., is a visual trail that represents all the activities as well as the relationships that individual activities have with other activities. The network is comprised of arrows (called *branches*) and circles (called *nodes*). Each node represents a finished activity or event. Dummy Activities may be inserted but will have no estimated times or activities associated with them.

Procedural Time Variations and Probabilities

The surgical services at Evans Army Community Hospital uses Department of the Army (DA) Form 4107, Operation Request and Worksheet, to collect pertinent information about each surgical case. Once collected, the information on the DA Form 4107 is then entered into the hospital's primary surgery scheduling system, Surgi-Server™ which serves as an operating room scheduling and management system. Surgi-Server™ allows the scheduler to allocate cases in block time or open time formats. Within the confines of the scheduling grid, scheduled cases are then represented by color, surgeon's name, and the name of the procedure for easy identification purposes. The system then archives historical data by case which may be downloaded into a variety of software languages. For the purpose of this study Microsoft Excel Version 5.0, a popular spreadsheet program, was utilized. Excel allows users a variety of options to better manipulate data. Once the data was arranged in an appropriate format in Microsoft Excel, it was imported into SPSS,

Version 6.0 for statistical analysis. Three distinct areas involving procedure times were analyzed using the above software. They included procedure lengths and probabilities, total room times, room turnover times, and start times. See Appendix 1 for a copy of DA Form 4107.

The common variables of interest which were used predominantly throughout the study are depicted in Table 2. The names, scales and operational definitions of each variable are shown.

Procedure Time is a continuous variable measured on a ratio scale of minutes. It is defined as the total procedure time from the "first cut" (incision) to the final suture and the value can be found in Block 44 of the DA Form 4107.

TABLE 2

COMMON VARIABLES USED THROUGHOUT THE STUDY

VARIABLE	SCALE	OPERATIONAL DEFINITION
Procedure Time	Ratio	Total procedure time from incision to close
Total Room Time	Ratio	Total amount of time that an operating room is in use
Delta Time	Ratio	Total Room Time minus Procedure Time
Anesthesia Time	Ratio	Total time for anesthesia - includes induction, maintenance, extubation
Emergency	Nominal	Emergent surgical procedure completed within 24 hours of diagnosis
Semi-Emergency	Nominal	Semi-emergent surgical procedure completed within 72 hours of diagnosis
Gender	Nominal	Gender of the patient
Beneficiary Status	Nominal	Eligibility category of the patient
Surgical Service	Nominal	The surgical service requesting to perform the operative procedure
Operating Room	Nominal	The operating room number used for each procedure
Patient In	Interval	The time a patient enters the operating room (hh/mm)
Patient Out	Interval	The time a patient leaves the operating room (hh/mm)
Scheduled Start	Interval	The time a patient was originally scheduled to enter the operating room (hh/mm)

Total Room Time is a continuous variable measured in minutes. It is defined as the total time an operating room was used for a particular case. It begins when the patient enters the room and includes the anesthesia time, the procedure time, the time

used to clean the room after the procedure, and the time used to set up for the next case. The value for this variable is located in Block 26 of the DA Form 4107.

Delta Time is a continuous variable measured in minutes. It is defined as Total Room Time minus Procedure Time. It measures the amount of elapsed time which occurs in the room performing activities other than the actual surgical procedure.

Anesthesia Time is a continuous variable measured in minutes. It is defined as the total time used by the anesthesiologist or anesthetist from the induction of anesthesia, through the maintenance, and ending with extubation. The value for this variable is found in Block 33 on the DA Form 4107.

Emergency is a dichotomous variable measured on a nominal scale. It is defined as an emergent surgical procedure which must be performed within 24 hours of diagnosis. Its value is found in Block 13 on the DA Form 4107. It is coded "1" if the procedure is an emergency and "0" otherwise.

Semi-Emergency is a dichotomous variable measured on a nominal scale. It is defined as a semi-emergent surgical procedure which must be performed within 72 hours of the diagnosis. Its value is found in Block 13 on the DA Form 4107. It is coded "1" if the procedure is semi-emergent and "0" otherwise.

Gender is a dichotomous variable measured on a nominal scale. It is defined as the gender of the patient undergoing the surgical procedure. It is coded "1" if the patient is male and "0" if the patient is female. The value for this variable is found in Block 6 of the DA Form 4107.

Beneficiary Status is defined as the eligibility category of the patient undergoing the surgical procedure. This variable is measured on a nominal scale which delineates eligibility types into five distinct categories. This variable was coded "1" if the patient was active duty, "2" if the patient was a family member of an active duty soldier, "3" if the patient was a retiree, "4" if the patient was a family member of a retiree, and "5" for other types of eligible beneficiaries. The term, "other" typically accounts for National Guardsmen or Reservists serving temporarily on active duty. The value for this variable can be found in Block 2 of the DA Form 4107.

Surgical Service is defined as the surgical service requesting to perform the operative procedure. It is measured on a nominal scale which delineates the variable into nine distinct categories. Surgical Service was coded "1" if the requesting service was General Surgery, "2" if it was Orthopedic Surgery, "3" if it was Ophthalmic Surgery, "4" if it was Otorhinolaryngologic Surgery, "5" if it was Genitourinary (Urology) Surgery, "6" if it was Gynecologic and Obstetric Surgery, "7" if it was Oral and Maxillofacial Surgery, "8" if it was Dental Surgery, and "9" if it was Podiatric Surgery. Values for this variable can be found in Block 10 of the DA Form 4107.

Operating Room is defined as the actual operating room where the operative procedure occurred. It is measured on a nominal scale. This variable was coded as "1" for Operating Room One, "2" for Operating Room Two, and so on. The value for this variable is found in Block 25 of DA Form 4107.

Patient In is defined as the time a patient enters the operating room. It is expressed using the hh/mm format. Its value may be found in Block 26 of DA Form 4107.

Patient Out is defined as the time a patient leaves the operating room. It is expressed using the hh/mm format. Its value may be found in Block 26 of DA Form 4107.

Scheduled Start is defined as the time that a patient was originally scheduled to enter the assigned operating room. Its value may be found in Blocks 11 and 12 of DA Form 4107.

Age is defined as the age of the patient at the time of surgery. It is a continuous variable measured on a ratio scale in years. The value for this variable may be found in Block 3 of the DA Form 4107. Cases involving patients under the age of two were entered into Surgi-Server™ with their age in months. When brought into Microsoft Excel, this researcher simply entered a formula to calculate an age in years. For example, if "9 months" was entered in Surgi-Server™, the formula "= 9/12" was inserted in the cell which would calculate the age as 0.75 years.

This area of the research is somewhat broad and therefore divided in to the following subheadings: procedure lengths and probabilities, operating room turnover rates, procedure time variations (includes Procedure Time, Anesthesia Time and Delta Time), and operating room start times. This particular area will be divided into these subheadings throughout the remainder of the study.

Procedure Lengths and Probabilities

In the operating room, time is one of the most precious resources. Schedulers within any operating room service are faced with the continuous challenge of determining appropriate case lengths in order to allocate valuable operating time within a particular service's block schedule. The high costs of equipping, maintaining, and staffing an operating room suite demand the efficient scheduling of resources. Many facilities rely heavily upon the surgeon's own estimate regarding the length of a given procedure before the scheduler allocates the block time. At Evans Army Community Hospital, this was the case until the fielding and implementation of Surgi-Server™. This system maintains the surgeon's average time for past procedures as well as the standard aggregate times overall for any one procedure. Still, managers and schedulers must have a clear understanding about the types of surgical cases booked and the lengths of those cases.

By allowing managers to see their case length distributions, they can make informed and intelligent decisions on how to best schedule those cases. Previous research (Hackey et al. 1984) determined that when services utilize block operating room schedules, they should develop policy dividing those blocks into two portions. The first portion of the block should be dedicated for long cases, defined as 90 minutes or more. The latter portion of the block should have shorter cases, 89 minutes or less, allocated against it. This creates a combination of block scheduling and longest-cases-first scheduling, a policy which results in increased theater utilization as well as the least amount of overtime (Goldman et. al. 1969).

The research question revolves around the distribution of both long cases and short cases within individual surgical services at Evans Army Community Hospital. What is the probability that a particular surgical service will have a long case or a short case? How should individual services divide their block schedules to best accommodate for these cases? To answer these questions, frequency and probability distribution tables were used.

Data from June 1995 to March 1996 was collected on Surgi-Server™ for evaluation. This information was imported into SPSS and descriptive statistics were generated for use in building both frequency and probability tables. An aggregate probability table was developed to provide the operating room supervisor with information pertaining to overall case lengths. Individual service probability tables were also constructed for the purpose of redesigning individual service scheduling blocks.

Operating Room Turnover

For this study, operating room turnover was defined as the amount of time in minutes that elapse from the moment a patient exits a particular operating room until the next patient enters that same operating room. Many things occur during the room turnover phase. Besides the next patient being prepared for surgery in the Same Day Surgery Clinic, the room has to be cleaned and properly set up for the next case. This is a cooperative effort between the circulating nurse, the scrub technician, the anesthesia technician and the housekeeping staff. Much emphasis is placed on speeding up the process of room turnover; however, it is important to remember that

what takes place after a patient leaves the room is extremely important for the total patient care concept. The primary mission during the room turnover phase is to contain and confine infectious organisms that may cause harm to the patient. Secondary purposes include stocking rooms with the necessary equipment and supplies for succeeding cases (Fairchild 1993).

The variables of interest include all previously mentioned variables. Another variable used for this portion of the study was: Date of Surgery. This variable is defined as the date in which the surgery was conducted. It is coded using the mm/dd/yy format.

The Surgi-Server™ database was queried to produce a case information report containing the variables of interest from October 1995 to March 1996. Once retrieved, the data was imported into Microsoft Excel. Once imported into the Excel spreadsheet, the data was arranged in a manner so that the variables Operating Room, Patient In, and Patient Out were displayed next to each other. The spreadsheet was arrayed by the variable Date of Surgery in order to look at an entire day's worth of surgical cases while not confusing that day with any other day. Surgical cases identified as the first cases for that particular day were immaterial because a turnover rate could not be associated with that case. Cases that seemed to have extraordinary breaks over the lunch hour were deleted as well. The assumption was that blocked cases were light that day, and the surgeons deliberately scheduled in a lunch break. Cases involving multiple procedures were also deleted because each procedure is entered into Surgi-Server™ as separate cases but assigned the same times. Cases with

missing information such as the operating room number or patient entry/exit times were also deleted from the study. Next, the rooms were isolated and examined individually on the spreadsheet. The patients entry time was then subtracted from the previous patient's exit time to produce a continuos variable, "Room Turnover", which was measured in minutes.

The research question for this area of study revolved around differences existing among groups. The stated Alternate Hypotheses follow:

Hypothesis 1: Operating room turnover varies as a function of group membership among the surgical services.

Hypothesis 2: Operating room turnover varies as a function of group membership among the operating rooms within the operating suite.

This data was then imported into SPSS in order to calculate the descriptive and inferential statistics. The analytical tool used was a one-way Analysis of Variance (ANOVA) to measure differences among the surgical service groups. The one-way ANOVA considers variation across all groups at once to determine differences among group means. The dependent variable (Y) was Room Turnover and the independent variables (X) were Surgical Service and Operating Room. Tukey's Honestly Significant Difference (HSD) Test was used as a post-hoc measure in order to decrease the likelihood of committing a Type I error. A p-value less than 0.05 was considered statistically significant. Once significant differences were identified, independent samples t test were used to compare the means identified by Tukey's HSD as significant.

Procedure Time Variations

The operating room is one area within a hospital with a great deal of potential to cause productivity problems. Deviations from the operating room schedule create a "ripple effect" that can cause problems for patients, physicians and the nursing staff throughout an entire day. That day's operating schedule becomes the primary tool for managers to plan their staffing, equipment, supplies and room needs. If cases run longer than their scheduled time, all subsequent surgical cases scheduled for that room will be delayed. This creates need for unprogrammed overtime and staffing. If allowed to continue, this can create a great deal of dissatisfaction among the operating room staff as well as the physician "customers" who rely on the accurate scheduling of their cases. This is why operating room supervisors must continuously monitor the variation that exists within surgical cases.

The research questions associated with this particular area of the study revolved around variation existing with Procedure Time, Delta Time and Anesthesia Time. The stated alternate hypotheses were:

Hypothesis 3: Procedure time measured from the first incision to the final closing suture varies as a function of group membership among the surgical services.

Hypothesis 4: Anesthesia time measured from induction to extubation varies as a function of group membership among the surgical services.

Hypothesis 5: The amount of elapsed time measured by the difference between the total room time and the procedure time (Delta Time) varies as a function of group membership among the surgical services.

The dependent variables for this portion of the study were: Procedure Time, Anesthesia Time and Delta Time. The independent variable was Surgical Service.

One-way ANOVA was used to determine if differences exist among the individual surgical services. Tukey's HSD was used as the post-hoc test to decrease the likelihood of making a Type I error. For those groups identified by Tukey's HSD as significantly different, further analysis was conducted with an independent samples *t* test.

Operating Room Starts

Concern about late starts is widespread at all surgical sites, and is a predominant theme within the literature pertaining to surgical management practices. Operating room start times are defined differently by various professionals. Surgeons feel that start times should be associated with the first incision. The nursing perspective associates operating room start times as the time a patient enters the room Mazzei 1994). This study will incorporate both definitions.

Like unscheduled variations in procedure times, late starts can exacerbate the day's operating schedule creating a variety of problems and inconveniences among patients, physicians and the nursing staff. Continuous abuses involving operating room starts can create dissatisfaction among the professionals and staff who must deal with those problems and inconveniences.

The purpose for this section of the study was to examine the phenomenon of late starts at Evans Army Community Hospital. Research questions included: 1) What is the frequency of late starts? 2) Do different services experience significantly different rates of late starts? and 3) What is the mean elapsed time occurring from

when a patient enters a room to when the first incision occurs and does it vary among services?

The following hypotheses pertaining to late starts in the operating room were tested:

Hypothesis 6: The actual rate of late starts occurring in the operating room varies significantly from the expected rate among the surgical services.

Hypothesis 7: The actual rate of late starts occurring in the operating room varies significantly from the expected rate among individual operating rooms.

Hypothesis 8: The duration between the time a patient arrives in the room and the time of the first incision (To Procedure) varies as a function of group membership among the surgical services.

In order to measure the nursing perspective of late starts, the Surgi-Server™ database was queried to provide a report of all surgical cases from September 1995 through March 1996. Once imported into Microsoft Excel, the data was arranged by the scheduled start time for each case. Only the first cases occurring each day were considered for nursing starts because they are the most critical. Delays in the first case will adversely effect all other cases for the remainder of the day. Furthermore, first cases represented the best opportunity for eventual process improvement. First cases of the day exhibited the least amount of dilution when studying delayed starts. Subsequent cases are often prevented from starting on time because of problems experienced by earlier cases. For this reason, all other cases were deleted from consideration. By subtracting the variable Patient In from Scheduled Start, a determination can be made on whether the case started on time.

Table 3 depicts additional variables used to analyze nursing starts in the operating room.

TABLE 3

VARIABLES ANALYZED FOR
NURSING STARTS IN THE OPERATING ROOM

VARIABLE	SCALE	OPERATIONAL DEFINITION
Late Time	Ratio	Patient In minus Scheduled Start
Late Start	Nominal	The procedure experienced a late start
On Time	Nominal	The procedure began on time

Late Time is a continuous variable measured on a ratio scale. It was derived by subtracting Scheduled Start from Patient In. It is defined as the amount of time in minutes that separates the scheduled start time from the actual start time.

Late Start is a dichotomous variable measured on a nominal scale. Late Start was coded "1" if a late start occurred and "0" if otherwise. Basically, if the difference between the scheduled start and the actual start is greater than zero, a late start occurred.

On Time is a dichotomous variable measured on a nominal scale. It reflects those Late Start values that were coded as "0" above. If the difference between the scheduled start and the actual start equals zero, the case occurred on time without a delayed start.

Since the pertinent variables for examining nursing starts are nominal, chi-square analysis was used to determine if statistically significant differences existed between "observed" late starts actually occurring during the specified time frame and

"expected" late starts. The chi-square analysis was used to discern late start rates for both surgical services and individual operating rooms.

Hypothesis 8 focuses on surgeon starts in the operating room. Data from June 1,1995 to March 21,1996 was collected from the Surgi-Server™ database to create a convenience sample for analysis (the same sample that was used to construct the probability tables). Nine cases were deleted from consideration because the Patient In value was missing. This resulted in a sample of 3,044 surgical cases. By subtracting Patient In from the time that the procedure began a new variable, To Procedure, was created.

To Procedure is a continuous variable measured on a ratio scale. It is defined as the amount of time that elapses from the moment a patient enters the operating room to the time of first incision.

The data was imported into SPSS in order to calculate both the descriptive and inferential statistics. The analytical tool used was a one-way ANOVA to measure the mean difference of To Procedure among the surgical services. The dependent variable (Y) was To Procedure and the independent variable (X) was Surgical Service. Tukey's HSD test was used as a post-hoc in order to decrease the likelihood of committing a Type I error. Once significant differences were identified by Tukey's HSD, independent samples *t* tests were used to compare means.

Delays Occurring in the Operating Room

A prior study conducted by Weimer (1993) was used as a model for measuring delays that occur in the operating suite at Evans Army Community Hospital. This

researcher decided to examine delays occurring in the operating room after witnessing an orthopedic case which was delayed for over an hour because the surgeon did not have the proper equipment on hand to complete the procedure. The nursing supervisor agreed that this issue warranted further investigation. Together, we outlined the planned study for her nursing staff and sought their input on how to best conduct the study. After providing the nursing staff with a copy of Weimer's data collection tool and discussing the meaning of the various delay codes, some modifications were made at their suggestion. The data collection tool consisted of a total of 52 codes, each representing a different delay cause. These codes were divided into five major domains or constructs. The five domains included environmental delays, delays caused by equipment/supplies, personnel influenced delays, information delays and patient delays. See Appendix 2 for a copy of the modified data collection tool.

The circulating operating room nurses would serve as recorders of the data as well as "expert" observers. They were chosen for this role because of their unique position within the surgical team. Certainly the surgeon is responsible for everything that occurs at the operating table, but he or she relies heavily upon the circulating nurse to manage and coordinate the many activities that occur within the room. The circulating nurse controls the operating room in such a manner as to relieve the surgeons from that distraction which better enables them to concentrate solely on the patient (Fairchild 1993).

Upon observing a delay, the operating room nurse would simply circle the appropriate code or codes on the data collection tool and then place the value of each delay in minutes next to the circled code(s). This process continued from January 16 to March 15, 1996. Every two weeks, Surgi-Server^{TM} was queried for the procedures occurring within that time period. Once imported into Microsoft Excel, the information contained on the Delay Data Collection Tool was added to the appropriate case.

Table 4 depicts the variables used to examine delays occurring in the operating room. The variable names, scales and definitions are portrayed.

Delay 1 is a dichotomous variable coded "1" if a delay occurred during that particular case or "0" if no delay occurred. It is measured on a nominal scale and defined as whether a delay occurs or not.

TABLE 4

VARIABLES USED TO EXAMINE
DELAYS OCCURRING IN THE OPERATING ROOM

VARIABLE	SCALE	OPERATIONAL DEFINITION
Delay 1	Nominal	Determines whether a delay occurred
Delay 1 Code	Nominal	Type of delay
Domain 1	Nominal	Construct/domain of delay type
Delay 1 Time	Ratio	The amount of time wasted by the delay
Delay 2	Nominal	Determines whether a second delay occurred
Delay 2 Code	Nominal	Type of second delay
Domain 2	Nominal	Construct/domain of second delay
Delay 2 Time	Ratio	The amount of time wasted by second delay
Total Delays	Ratio	Total number of delays
Total Delay Time	Ratio	Total amount of time wasted by delays

Delay 1 Code is a nominal variable defined as the type of delay that occurred. It was coded 0 through 52. A code of "0" represents "no delay occurred" while 1 through 52 represent separate and distinct delays.

Domain 1 is a nominal variable defined as the construct or domain of the delay. It was coded 0 through 5. A code of "0" signifies that no delay occurred. Domain 1 was coded "1" if the delay construct pertained to the environment, "2" if the delay construct pertained to equipment/supplies, "3" if the delay construct pertained to personnel, "4" if the delay construct pertained to information and "5" if the delay construct pertained to the patient.

Delay 1 Time is a continuous variable representing the extent of the delay in minutes and measured on a ratio scale. It was derived through direct observation and represents an estimate by the circulating operating room nurse assigned to the case.

The variables, Delay 2, Delay 2 Code, Domain 2 and Delay 2 Time were utilized for cases experiencing a second recorded delay and are coded, measured and defined as indicated above. No cases experienced a third delay.

Total Delays is defined as the total number of delays occurring within each surgical case. It was derived by adding Delay 1 and Delay 2.

Total Delay Time is a continuous variable representing the total time consumed by delays within each surgical case. It represents the sum of Delay 1 Time and Delay 2 Time and is measured on a ratio scale.

Research questions posed for this portion of the study included the following: 1) How much time is consumed by delays occurring in the operating room? 2) What

are the causes for these delays? 3) What are the most frequent causes of delays occurring in the operating room? 4) Do particular surgical services experience more delays than other services?

There were two stated alternate hypotheses pertaining to delays occurring within the operating room:

Hypothesis 9: The time consumed with delays occurring within the operating room varies as a function of group membership among the surgical services.

Hypothesis 10: The actual rate of case delay occurrences within the operating rooms varies significantly from the expected rate among the surgical services.

SPSS was used to conduct the appropriate inferential tests for each hypothesis. Hypothesis 9 was tested using one-way ANOVA with Total Delay Time serving as the dependent variable (Y) and Surgical Service serving as the independent variable (X). Hypothesis 10 was tested using chi-square analysis. The dependent variable (Y) was the dichotomous variable, Delay 1, while the independent variable (X) was Surgical Service.

Surgical Cancellations

For this portion of the study, the term, surgical cancellations, was defined as any cancellation less than two days out from the scheduled date of the procedure. The operating room schedule becomes final after it has been signed by an anesthesiologist. This typically occurs two days out, and therefore, cancellations occurring greater than two days out from the scheduled date of the procedure does not appear on the finalized schedule and therefore does not officially count as a cancellation.

Surgical cancellations for the current fiscal year (October 1995 to April 96) were examined. Cancellations are tracked by the operating room supervisor using Surgi-Server™. The operating room supervisor created the following 26 codes to track root causes for cancellations. The 26 codes fall into 5 individual domains: administrative (code 1), operating room (code 14), surgeon (codes 3-13), patient (codes 15-26) and unknown (code 2).

Code 1 - Clerical Error. This covers both the clerks within the individual surgical services as well as the scheduling clerks within the operating suite who might inadvertently enter erroneous information.

Code 2 - Cancellation Reason Unknown. There are times when cases are canceled without any reason being given to the scheduling clerk. This code has become increasingly less utilized as case cancellation rates have become more heavily scrutinized.

Code 3 - Abnormal lab, x-ray, EKG. These are usually discovered in the pre-admission clinic, and the information is expedited to the surgeon who must decide whether to continue with surgery or not.

Code 4 - Done as an Emergency. This code typically applies to c-sections. Usually these are scheduled, however, once the patient goes into labor the procedure is done as an emergency.

Code 5 - Doctor on Emergency Leave. This code is self explanatory.

Code 6 - Need Further Evaluation. Usually this code is triggered by "unknown" medical problems that require a medical evaluation.

Code 7 - Doctor Ill/Injured. This code is self explanatory.

Code 8 - Medical Complication. Usually this code is triggered by "known" medical problems that require a medical evaluation (e.g., hypertension, high glucose levels).

Code 9 - No Explanation Given. This code applies when the surgeon cancels the procedure without offering an explanation. It is different from code 2 in that the cancellation was physician initiated.

Code 10 -Surgery Not Needed Now. This code applies when the medical condition corrects itself. An example would be a ganglion cyst that bursts and therefore does not require surgical intervention.

Code 11 - Surgeon Overbooked. This code applies when the surgeon scheduled more cases than he or she could perform during a given block time.

Code 12 - Surgeon Unavailable. The surgeon is not at the scheduled operating room at the scheduled time.

Code 13 - Surgeon, Other. This code applies when the surgeon cancels a procedure for a reason not mentioned above in codes 3 through 12.

Code 14 - Operating Room Equipment Unavailable. This code is self explanatory.

Code 15 - Patient AWOL. This code is self explanatory.

Code 16 - Patient Changed Mind. This code is self explanatory but applies only to elective procedures.

Code 17 - Patient Done in Clinic. Although scheduled for surgery within the surgical suite, a patient may come in and have the procedure done within the clinic.

Code 18 - Patient Deployed. This code is self explanatory.

Code 19 - Patient on Emergency Leave. This code is self explanatory.

Code 20 - Patient No Show. This code is self explanatory.

Code 21 - Patient Not NPO. The order, NPO (nothing per oral), requires that the patient refrain from ingesting fluids or solids orally before a procedure. Compliance drops moderately with this order when applied to children.

Code 22 - Patient Pregnant. This code is self explanatory.

Code 23 - Patient Refuses Surgery. This code differs from 16 in that the procedure is required, not elective. The patient disregards the medical advice to have surgery.

Code 24 - Patient Ill. This code applies when the patient, usually a child, presents with a slight illness that prevents surgery (e.g., elevated temperatures, runny nose, sore throat).

Code 25 - Patient Not Authorized Care. This code applies when a patient is erroneously scheduled for routine surgery but is not an authorized beneficiary of the MHSS.

Code 26 - Patient, Other. This code applies to a cancellation caused by the patient for a reason other than offered from codes 15 through 25.

The research questions for this portion of the study revolve around the rates and frequencies of individual cancellation codes and domains. Because Surgi-Server™

does not track any other information but the code and frequency, no statistical evaluations can be made.

Patient Satisfaction

An instrument developed by Forbes and Brown (1995) was used to measure satisfaction among the surgical patients at Evans Army Community Hospital. This researcher contacted Ms. Forbes at Catawba Memorial Hospital in Hickory, North Carolina seeking permission to use their survey. Ms. Forbes graciously provided that permission and sent a copy of the questionnaire. Forbes and Brown developed their instrument with the participation of 12 nurses serving as experts. Forbes and Brown surveyed the 12 nurses using a modified Delphi technique to evaluate both content and face validity of each question as well as to determine the appropriate nursing constructs associated with each item. After undergoing several rounds using the modified Delphi technique, Forbes and Brown grouped their questions into the following constructs or domains: caring, continuity of care, competency and the education of patients and family members.

Forbes and Brown defined their constructs in the following manner:

> Caring is defined as an interpersonal interaction or therapeutic intervention or process between nurses and patients, family members, or care partners. Questions in this domain focus on respect, concern, compassion, and acceptance . . .
>
> Continuity of care is defined as the care and interventions that are coordinated throughout the perioperative process. Continuity of care involves care that is effective, consistent, individualized, and given in a timely manner. Questions in this domain pertain to aspects of care and information related to services, treatments, and outcomes of care.

Competency of nurses is defined as patients' perceptions of the behavior and manner in which services, information, and care are given. Questions in this domain focus on the nursing interactions that decrease patients' physical and emotional anxiety and discomfort.

Education is defined as the ability of nurses to enable patients and family members to make informed decisions for management of patients' health problems.

Forbes and Brown used the test-retest methodology to determine the reliability of their 21-item instrument. They utilized the Pearson product-moment correlation coefficient to examine how strong of a relationship each question has with another. Their analysis of the 21 questions resulted in a range from 0.55 to 1.00, with a statistical significance level of .0001 for the first twenty questions. Question 21 resulted in a p value of .40 and therefore was not statistically significant. Forbes and Brown measured the internal consistency of their instrument using Cronbach's alpha coefficient. The alpha scores ranged from 0.19 to 0.80. The overall Cronbach's alpha coefficient was 0.83, representative of a moderately high level of reliability (Forbes and Brown 1995).

The Forbes-Brown instrument was modified by adding four questions seeking demographic information (i.e., surgical service, beneficiary status, gender, age). At the request of the nursing staff, three open-ended questions were added to the instrument but not used in the final analysis. Finally, Question 21 was deleted from the instrument circulated at Evans Army Community Hospital because of its previously insignificant reliability score and on the advice of Ms. Forbes.

The modified patient satisfaction survey consisted of 4 demographic questions, 20 closed-ended questions measured on a Likert scale (1 = Strongly Agree, 2 = Agree,

3 = Neutral, 4 = Disagree, 5 = Strongly Disagree) and 3 open-ended questions soliciting input on how the hospital can better serve them in the future. See Appendix 3 for a copy of the survey.

The surveys were placed with the receptionists at the following services: General Surgery, Orthopedic Surgery, Ophthalmology, Otorhinolaryngology and Urology. Oral Surgery, Dental Services and Podiatry were excluded because of the low volume of nursing care associated with each service. Obstetrics and Gynecology was also excluded because of the sensitive nature of the procedures performed by the service. It would be extremely insensitive of this organization to provide a patient satisfaction survey to a woman who recently underwent a radical hysterectomy.

Once positioned at the various clinic reception desks, receptionists offered the instrument to patients presenting for post-surgical follow-up care. The instructions associated with the Forbes-Brown instrument indicated that participation was purely voluntary and that respondent identities would be held in the strictest confidence. This researcher's name and phone number was also included if respondents had questions pertaining to the instrument or the results of the survey. Parents of small children who underwent surgery were also invited to participate by filling out the instrument.

The data from the survey was collected and then input into Microsoft Excel. Scores from the twenty Likert questions were tabulated and then added to create the variables used for this portion of the study. Table 5 depicts the names, scales and definitions of those variables.

Total Satisfaction is a continuous variable measured on an interval scale and reflects the sum of all twenty questions. A range of 20 to 100 is possible. It is defined as the total measurable satisfaction felt by surgical patients who responded to the Forbes-Brown instrument.

TABLE 5

VARIABLES PERTINENT TO PATIENT SATISFACTION
SURGICAL SERVICES AT EVANS ARMY COMMUNITY HOSPITAL

VARIABLE	SCALE	OPERATIONAL DEFINITION
Total Satisfaction	Interval	The sum of all 20 items
Care Total	Interval	The sum of the 6 items pertaining to the Caring construct
Competence Total	Interval	The sum of the 5 items pertaining to the Competence construct
Continuity of Care Total	Interval	The sum of the 4 items pertaining to the Continuity construct
Education Total	Interval	The sum of the 5 items pertaining to the Education construct
Surgical Service	Nominal	The surgical clinic where the instrument was completed
Beneficiary Status	Nominal	The eligibility status of the survey respondent
Age	Ratio	The age of the respondent
Gender	Nominal	The gender of the respondent

Care Total is a continuous variable measured on an interval scale and reflects the sum of the six questions attributed to the construct of "caring." A range of 6 to 30 is possible.

Competence Total is a continuous variable measured on an interval scale and reflects the sum of the five questions attributed to the construct of "competence." A range of 5 to 25 is possible.

Continuity of Care Total is a continuous variable measured on an interval scale and reflects the sum of the four questions attributed to the construct of "continuity of care." A range of 4 to 20 is possible.

Education Total is a continuous variable measured on an interval scale and reflects the sum of the five questions attributed to the construct of "patient and family education." A range of 5 to 25 is possible.

Surgical Service is a defined as the surgical clinic where the respondent presented for post surgical follow-up care. It is measured on a nominal scale and was coded "1" for General Surgery, "2" for Orthopedic Surgery, "3" for Ophthalmology, "4" for Otorhinolaryngology and "5" for Urology.

The following hypotheses were tested:

<u>Hypothesis 11</u>: The total score for satisfaction varies as a function of group membership among the surgical services.

<u>Hypothesis 12</u>: The total score for caring varies as a function of group membership among the surgical services.

<u>Hypothesis 13</u>: The total score for competence varies as a function of group membership among the surgical services.

<u>Hypothesis 14</u>: The total score for continuity of care varies as a function of group membership among the surgical services.

<u>Hypothesis 15</u>: The total score for education of patients and family members varies as a function of group membership among the surgical services.

SPSS was used to conduct the appropriate inferential tests for each hypothesis. Hypotheses 11 through 15 were tested using one-way ANOVA with the variables representing individual constructs serving as the dependent variable (Y) and Surgical Service serving as the independent variable (X). Tukey's HSD was used as a post-hoc. Significant mean differences were further analyzed using independent samples *t* tests to compare the means.

CHAPTER 3

THE RESULTS

The Results from Examining the Surgical Service Process

The surgical service process at Evans Army Community Hospital is primarily linear requiring that certain prerequisite steps be completed before progressing further in the process. Figure 3 portrays this process in the form of a PERT Chart. Certainly some steps can be skipped or completed later in the process, but that is a rare occurrence.

TABLE 6

ACTIVITY LIST FOR THE SURGICAL SERVICE LINE

ACTIVITY	DESCRIPTION	PREDECESSOR
A	Identify Surgical Candidate	
B	Refer to Surgeon	A
C	Surgical Clinic Appointment	B
D	Administrative Process	C
E	Dummy Activity	D
F	Third Party Collections	D
G	Admissions	F
H	Interlude Period	F,G
I	Pre-Admissions Appointment	H
J	Interlude Period	I
K	Same Day Surgery Appointment	J
L	Dummy Activity	E
M	Surgical Procedure	K
N	Post Anesthesia Care Unit	M
O	Discharge or Admit to Ward	N

The initial step in determining the surgical process was simply identifying the major activities that comprise the service. This was accomplished by visiting the key players involved with the surgical service line at Evans Army Community Hospital. Table 6 provides a list of these major activities, and Table 7 provides estimated times for each activity measured in 8 hour work days.

Activity A, "Identify the Surgical Candidate," is most often performed by primary care physicians usually within a primary care setting or emergency room setting. For routine surgical patients, this activity typically requires a series of diagnostic tests and follow-up patient appointments. Once identified as a potential candidate for surgery, the patient is referred to the appropriate surgeon for consultation. Activity B, "Refer to Surgeon," usually takes about 3 weeks for routine consultations at Evans Army Community Hospital (Edinger 1996).

The purpose of Activity C, "Surgical Clinic Appointment," is to confirm whether the patient is indeed a viable candidate for surgery through clinical examination. According to Major (Dr.) Michael C. Hotard, Chief of General Surgery, approximately 50 percent of the patients referred to his service simply are not viable candidates for surgery and would be better served in a primary care setting (Hotard 1996).

Activity D represents the various administrative requirements necessary to facilitate the required surgery. This typically entails gaining informed consent from the patient, a process involving a complete description of the proposed surgical procedure as well as potential complications and side effects. The surgeon must complete a

clinical record detailing the necessary doctor's orders to facilitate the procedure. Elements of the doctor's orders consist of, but are not limited to, the diagnosis, the procedure, known allergies, vital signs, diet, required laboratory tests, x-rays, pre-operative instructions and medications. Finally, the surgeon initiates the required admission and coding paperwork used to begin the pre-admission process (Hotard 1996).

TABLE 7

ESTIMATED TIMES FOR
INDIVIDUAL ACTIVITIES WITHIN THE SURGICAL SERVICE LINE

ACTIVITY CODE	OPTIMISTIC (a)	PROBABLE (m)	PESSIMISTIC (b)	EXPECTED (t)	STANDARD DEVIATION
A	1.00	14.00	30.00	14.50	4.83
B	14.00	21.00	28.00	21.00	2.33
C	0.13	0.13	0.25	0.15	0.02
D	0.25	0.38	0.50	0.38	0.04
F	1.00	5.00	10.00	5.17	1.50
G	1.00	5.00	10.00	5.17	1.50
H	1.00	7.00	14.00	7.17	2.17
I	0.25	0.38	0.50	0.38	0.04
J	1.00	7.00	15.00	7.33	2.33
K	0.25	0.38	0.50	0.38	0.04
M	0.25	0.38	0.75	0.42	0.08
N	0.13	0.25	0.50	0.27	0.06
O	0.13	0.13	0.25	0.15	0.02

Perhaps the most critical element within Activity D is the actual scheduling of the operation. For routine, elective procedures this is a joint effort between the surgeon who knows his or her service's block schedule in the operating room and the patient who must coordinate his or her work activities, school activities, family issues, and a host of other activities. Once a mutually agreeable time and date for the procedure has been determined the surgeon will annotate the clinic's internal surgical

schedule (usually a database that portrays available block time) and then notifies the surgical suite by completing the top section of the DA Form 4107 (Hotard 1996).

Activity F, "Third Party Collections" and Activity G, "Admissions" are necessary patient activities required to facilitate the pre-admission process. These steps occur after the clinic visit with the surgeon and generally requires that the patient devote additional time within the hospital in order to complete. The time required to complete these steps are arbitrary and represent the best guess between the researcher and Captain Timothy Holt who oversees Third Party Collections.

Activity F is necessary because of a legal requirement to notify insurance companies of pending surgical procedures resulting in a hospital stay of one day or more. Failure to notify third party payers may result in monetary penalties consisting of $500 or 50 percent of the final bill. Technicians at the Third Party Collections office screen the patients for medical insurance and have them complete the necessary insurance forms to expedite billing.

Activity G consists of a variety of steps required for pre-admission to the hospital. Technicians educate patients about their rights within the hospital as well as their responsibilities as patients. Advanced directives such as living wills, medical durable powers of attorney and "do not resuscitate" orders are explained in detail. Patients are also given information pertaining to the various services offered by the hospital such as patient representation, pastoral services and dining facility services. Billing procedures are explained. Safety issues such as patient escort measures, fire alarm activities and smoking are addressed. The admissions office is responsible for

generating inpatient records, hospital identification cards and wristbands and entering the patient administration information into the hospital's automated database system (Jones 1996).

Activity H, the interlude period that precedes the patient's appointment with the pre-admission clinic provides the admissions office with the necessary time to complete some of their activities (i.e., generate the inpatient records, identification card and wristband). This period also allows the pre-admission clinic to manage their appointments. Ideally, patients should present a week to ten days before the scheduled surgery.

Activity I, the "Pre-Admissions Appointment," consists of a variety of complex tasks oriented toward facilitating the pending surgical procedure. It is here that medical records are obtained and charts are collated to facilitate the continuity of care. This encounter is also used to ease patient fears and address patient and family questions. The Pre-Admissions Clinic at Evans Army Community Hospital operates a remote lab to comply with most doctor's orders pertaining to laboratory tests. Any required x-rays or electrocardiograms (EKGs) are also facilitated at this time. Once the diagnostic test results are obtained, the staff screens them for abnormalities and then takes the appropriate steps (i.e., notify surgeon, facilitate additional tests). The nursing preoperative assessment occurs during this encounter as well. This assessment is used to determine the patient's nursing care needs and assists the nurse with developing an individualized care plan complete with goals, nursing history and a nursing diagnosis. The nursing assessment also provides an opportunity for the nurse

to orient the patient (as well as family members) to the facility as well as to any policies or rules inherent within the hospital. This is to better prepare the patient for the postoperative period. The nurse will also answer any questions from patients and family members as well as provide more detailed preoperative teaching as supplemental information. Any preoperative instructions (i.e., food/fluid intake, arrival time, no makeup or jewelry) are also issued at this time.

The patient also consults with an anesthesiologist or anesthetist during this activity. The purpose of the anesthesia consultation is to address any questions or concerns the patient might have as well as to assess the patient for potential intraoperative complications that might result through the introduction of anesthetic agents to the body. They also assess the patient's health status and formulate a plan for anesthesia care based on this assessment and the patient's own input (Siemieniec 1995).

Activity J represents another interlude period which occurs before the patient presents to the Same Day Surgery Clinic. For routine cases, this period is typically 7 to 9 days (Siemieniec 1995).

Activity K, "Same Day Surgery Appointment," occurs the day of surgery. First the patient's identity is verified as well as the procedure, site and surgeon. This activity is solely devoted to preparing the patient for surgery. Prepatory procedures might include an enema to empty the bowel and rectum, a douche before a gynecological procedure, starting an IV and hair removal from around the operative site. Patients are gowned and instructed to don a surgical cap. Jewelry, dentures and

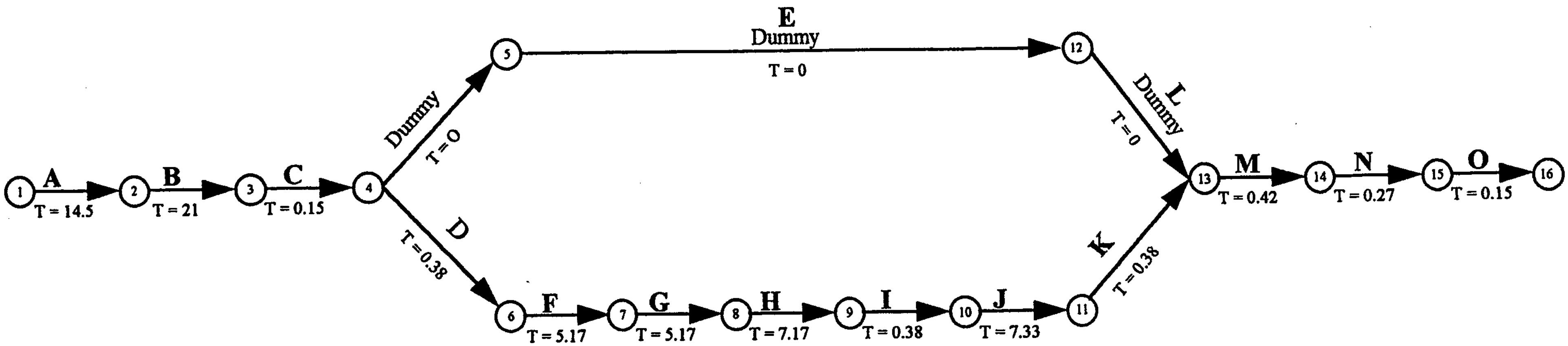

Fig. 3. Pert diagram outlining the surgical service process at Evans Army Community Hospital

removable prosthetics are taken away and placed elsewhere for safekeeping. A key function of the Same Day Surgery staff is to assist the preoperative patient in relieving tension. Surgery is repulsive to most people and causes a great deal of anxiety and fear. An effort is made during this activity to comfort both the patient and family members and ease any fears. Patients are then transported via stretcher to the outer corridor of the surgical suite where they are met by operating room personnel. It is here where the patient is transferred into the hands of the operating room team and enters the sterile environment of the operating suite.

Activity M, the "Surgical Procedure," consists of not only the surgical procedure but the induction and monitoring of the anesthesia as well. Immediately following the procedure, the patient is transported to the post anesthesia care unit, Activity N, where the patient is continuously monitored and observed until he or she returns to a safe physiological level after anesthetic. If the patient is to be discharged, Activity O, the following criteria must be met:

1. Stable vital signs
2. Gag reflex must be present; able to swallow and cough
3. Ambulate per developmental age or physical limitation
4. Absence of respiratory distress
5. Alert, oriented
6. Absence of bleeding
7. Void
8. Clear vision
9. No excessive pain

Not all patients receive surgical care on an ambulatory basis. If the patient requires a hospital stay after the procedure, they are simply transferred to the appropriate ward following their recovery (Siemieniec 1995).

Procedure Time Variations and Probabilities: The Results

Time is perhaps the most precious resource within the surgical service line. It is also the most difficult to manage. Operating room supervisors must maintain a critical eye on this particular resource. This study examines procedure lengths and probabilities, operating room turnover, time variations among surgical services, and operating room start times.

Results of Procedure Lengths and Probabilities

A convenience sample of 3051 surgical cases conducted from June 1, 1995 to March 21, 1996 were reviewed to construct probability tables pertaining to the lengths of surgical procedures. Of the cases reviewed, 160 (9.5 percent) were considered emergency cases and 280 (9.2 percent) were considered to be semi-emergency cases. Males comprised 46.7 percent of these cases (1,424 cases) while females made up the remaining 53.3 percent (1,627 cases). Table 8 below depicts cases by beneficiary category. Active duty soldiers and their families comprised nearly 70 percent of the cases reviewed which is inconsistent with data pertaining to the population (DMIS 1996). The Defense Medical Information System's (DMIS) Population Database reports that active duty members and their families comprise 58 percent of the eligible beneficiary population within the catchment area. Retirees and their familes comprise approximately 38 percent of the eligible beneficiary population.

TABLE 8

FREQUENCY DISTRIBUTION
BY INDIVIDUAL BENEFICIARY CATEGORY

BENEFICIARY CATEGORY	FREQUENCY	PERCENTAGE
Active Duty	941	30.84%
Family Member of Active Duty	1,173	38.45%
Retiree	424	13.90%
Family Member of Retiree	453	14.85%
Other	60	1.97%
Total:	3,051	100%

Table 9 depicts the frequency of cases by individual surgical service. General surgery, orthopedic surgery and obstetrics and gynecology services comprise over 64 percent of the cases reviewed. Probability tables were not constructed for oral surgery and dental services because together they comprise less than 3 percent of the total procedures performed.

TABLE 9

FREQUENCY DISTRIBUTION
BY INDIVIDUAL CLINICAL SERVICE

SERVICE	FREQUENCY	PERCENTAGE
General Surgery	634	20.78%
Orthopedic Surgery	690	22.62%
Ophthalmology	196	6.42%
Otorhinolaryngology	410	13.44%
Urology	262	8.59%
Obstetrics and Gynecology	629	20.62%
Oral Surgery	43	1.41%
Dental	23	0.75%
Podiatry	164	5.38%
Total:	3051	100%

A total of 634 procedures performed by the general surgery service were reviewed. Table 10 delineates the frequencies and probabilities of general surgical

procedure times which are organized and classed into 30 minute intervals. There is a probability of 0.65 that a general surgical procedure will last 89 minutes or less.

TABLE 10

PROBABILITY DISTRIBUTION
FOR THE GENERAL SURGERY SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	43	0.07	0.07
30 to 59	211	0.33	0.40
60 to 89	161	0.25	0.65
90 to 119	75	0.12	0.77
120 to 149	42	0.07	0.84
150 to 179	29	0.05	0.88
180 to 209	13	0.02	0.91
210 to 239	19	0.03	0.94
240 to 269	14	0.02	0.96
270 to 299	7	0.01	0.97
300 - up	20	0.03	1.00
Totals:	634	1.00	

A total of 690 procedures performed by the orthopedic surgery service were reviewed. Table 12 below delineates the frequencies and probabilities of orthopedic procedure times. There is a probability of 0.64 that an orthopedic procedure will last 89 minutes or fewer.

TABLE 12

PROBABILITY DISTRIBUTION
FOR THE ORTHOPEDIC SURGERY SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	77	0.11	0.11
30 to 59	211	0.31	0.42
60 to 89	156	0.23	0.64
90 to 119	102	0.15	0.79
120 to 149	73	0.11	0.90
150 to 179	34	0.05	0.95
180 to 209	16	0.02	0.97
210 to 239	11	0.02	0.99
240 to 269	5	0.01	0.99
270 to 299	3	0.00	1.00
300 - up	2	0.00	1.00
Totals:	690	1.00	

A total of 196 procedures performed by the ophthalmology service were reviewed. Table 13 below delineates the frequencies and probabilities of the ophthalmologic procedure times. There is a probability within the ophthalmology service of 0.82 that a procedure will last 89 minutes or less.

TABLE 13

PROBABILITY DISTRIBUTION
FOR THE OPHTHALMOLOGIC SURGERY SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	28	0.14	0.14
30 to 59	84	0.43	0.57
60 to 89	49	0.25	0.82
90 to 119	22	0.11	0.93
120 to 149	9	0.05	0.98
150 to 179	1	0.01	0.98
180 to 209	0	0.00	0.98
210 to 239	2	0.01	0.99
240 to 269	1	0.01	1.00
270 to 299	0	0.00	1.00
300 - up	0	0.00	1.00
Totals:	196	1.00	

A total of 410 procedures performed by the otorhinolaryngology service were reviewed. Table 14 below delineates the frequencies and probabilities of the otorhinolaryngologic procedure times. There is a probability of 0.90 that a procedure will last 89 minutes or less.

TABLE 14

PROBABILITY DISTRIBUTION FOR THE OTORHINOLARYNGOLOGIC SURGERY SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	207	0.50	0.50
30 to 59	121	0.30	0.80
60 to 89	39	0.10	0.90
90 to 119	15	0.04	0.93
120 to 149	10	0.02	0.96
150 to 179	10	0.02	0.98
180 to 209	3	0.01	0.99
210 to 239	3	0.01	1.00
240 to 269	1	0.00	1.00
270 to 299	1	0.00	1.00
300 - up	0	0.00	1.00
Totals:	410	1.00	

A total of 262 procedures performed by the urology service were reviewed. Table 15 below delineates the frequencies and probabilities of urologic surgical procedure times. There is a probability of 0.78 that a procedure will last 89 minutes or less.

TABLE 15

PROBABILITY DISTRIBUTION
FOR THE UROLOGIC SURGERY SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	52	0.20	0.20
30 to 59	111	0.42	0.62
60 to 89	42	0.16	0.78
90 to 119	26	0.10	0.88
120 to 149	13	0.05	0.93
150 to 179	10	0.04	0.97
180 to 209	4	0.02	0.98
210 to 239	1	0.00	0.99
240 to 269	1	0.00	0.99
270 to 299	0	0.00	0.99
300 - up	2	0.01	1.00
Totals:	262	1.00	

A total of 629 procedures performed by the obstetrics and gynecology service were reviewed. Table 16 below delineates the frequencies and probabilities of obstetrics and gynecological procedure times. There is a probability of 0.83 that a procedure will last 89 minutes or less.

TABLE 16

PROBABILITY DISTRIBUTION FOR THE
GYNECOLOGY AND OBSTETRICS SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	139	0.22	0.22
30 to 59	272	0.43	0.65
60 to 89	110	0.17	0.83
90 to 119	59	0.09	0.92
120 to 149	28	0.04	0.97
150 to 179	11	0.02	0.98
180 to 209	6	0.01	0.99
210 to 239	1	0.00	1.00
240 to 269	2	0.00	1.00
270 to 299	1	0.00	1.00
300 - up	0	0.00	1.00
Totals:	629	1.00	

A total of 164 procedures performed by the podiatry service were reviewed. Table 17 below delineates the frequencies and probabilities of podiatric surgical procedure times. There is a probability of 0.83 that a procedure will last 89 minutes or less.

TABLE 17

PROBABILITY DISTRIBUTION
FOR THE PODIATRY SERVICE

CLASS (minutes)	FREQUENCY (n)	PROBABILITY (p)	CUMULATIVE PROBABILITY
0 to 29	15	0.09	0.09
30 to 59	68	0.41	0.51
60 to 89	53	0.32	0.83
90 to 119	22	0.13	0.96
120 to 149	5	0.03	0.99
150 to 179	1	0.01	1.00
180 to 209	0	0.00	1.00
210 to 239	0	0.00	1.00
240 to 269	0	0.00	1.00
270 to 299	0	0.00	1.00
300 - up	0	0.00	1.00
Totals:	164	1.00	

Results of Operating Room Turnover

A sample of 731 surgical cases were examined in order to measure room turnover rates. Table 18 depicts the frequency of these cases by surgical service. The grand mean for room turnover rate was 21.93 minutes with a standard deviation of 11.70 minutes. Turnover rates from the sample ranged from 2 minutes to 77 minutes.

TABLE 18

FREQUENCY DISTRIBUTION TABLE
OF CASES BY INDIVIDUAL SURGICAL SERVICES

SERVICE	FREQUENCY	PERCENTAGE
General Surgery	122	16.69%
Orthopedic Surgery	140	19.15%
Ophthalmology	58	7.93%
Otorhinolaryngology	166	22.71%
Urology	69	9.44%
Obstetrics and Gynecology	93	12.72%
Oral Surgery	6	0.82%
Dental	5	0.68%
Podiatry	72	9.85%
Total:	731	100%

Group means for room turnover time by surgical services are displayed in Table 19. Room turnover was longest within the oral surgery service with a mean of

TABLE 19

GROUP MEANS FOR ROOM
TURNOVER AMONG SURGICAL SERVICES

SURGICAL SERVICE	MEAN	SD	n
General Surgery	23.39	11.88	122
Orthopedic Surgery	24.01	12.39	140
Ophthalmology	19.71	9.53	58
Otorhinolaryngology	18.84	11.66	166
Urology	23.42	10.49	69
Obstetrics/Gynecology	22.97	10.46	93
Oral Surgery	38.33	10.50	6
Dental Services	18.00	10.37	5
Podiatry	20.49	12.22	72

38.33 minutes. It is important to note, however, that only six cases were examined within the oral surgery service. Dental services, otorhinolaryngology, and ophthalmology all resulted in turnover times under 20 minutes.

Table 20 depicts the results of the one-way ANOVA for Hypothesis 1 which stated that "operating room turnover varies as a function of group membership among the surgical services." The analysis resulted in a statistically significant F ratio of 4.59 which was notable at level 0.0001 ($F_{8,722)} = 4.59$, $p < .0001$). The null hypothesis was rejected. Statistically significant variation of room turnover rates exist among the surgical services at Evans Army Community Hospital.

Tukey's HSD post hoc test indicated significant differences among the following groups: 1) otorhinolaryngology and general surgery, 2) otorhinolaryngology and orthopedic surgery, 3) otorhinolaryngology and oral surgery, 4) ophthalmology and oral surgery, 5) podiatry and oral surgery, 6) obstetrics and gynecology and oral surgery, and 7) general surgery and oral surgery.

TABLE 20

ANOVA TABLE REFLECTING
VARIANCE OF ROOM TURNOVER AMONG THE SURGICAL SERVICES

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	8	4838.97	604.87	4.59	.0000
Within	722	95144.75	131.78		
Total	730	99983.72			

Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test in order to further scrutinize mean differences existing between two groups. Table 21 reports the findings of these tests. The reported mean difference of room turnover time between otorhinolaryngology and general surgery was significant at $t_{(286)} = 3.25$, $p = .001$. The reported mean difference of room turnover time between

otorhinolaryngology and orthopedic surgery was significant at $t_{(304)} = 3.76$, $p < .001$. The reported mean difference of room turnover time between oral surgery and otorhinolaryngology was significant at $t_{(170)} = 4.04$, $p < .001$. The reported mean difference of room turnover time between oral surgery and ophthalmology was significant at $t_{(62)} = 4.52$, $p < .001$. The reported mean difference of room turnover time between oral surgery and podiatry was significant at $t_{(76)} = 3.47$, $p = .001$. The reported mean difference of room turnover time between oral surgery and obstetrics and gynecology was significant at $t_{(97)} = 3.49$, $p = .001$. The reported mean difference of room turnover time between the oral surgery service and general surgery was significant at $t_{(126)} = 3.02$, $p = .003$.

TABLE 21

ROOM TURNOVER BY SERVICE
INDEPENDENT SAMPLES *t* TESTS OF THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	*t*	p<=
Otorhinolaryngology	18.84	11.66	General Surgery	23.39	11.88	3.25	0.001
Otorhinolaryngology	18.84	11.66	Orthopedic Surgery	24.01	12.39	3.76	0.001
Otorhinolaryngology	18.84	11.66	Oral Surgery	38.33	10.5	4.04	0.001
Ophthalmology	19.71	9.53	Oral Surgery	38.33	10.5	4.52	0.001
Podiatry	20.49	12.22	Oral Surgery	38.33	10.5	3.47	0.001
Obstetrics/Gynecology	22.97	10.46	Oral Surgery	38.33	10.5	3.49	0.001
General Surgery	23.39	11.88	Oral Surgery	38.33	10.5	3.02	0.003

Table 22 reports the frequencies of surgical cases by individual operating rooms. The bulk of the cases occurred in rooms 1, 3, and 6. Table 23 reports the descriptive statistics associated with each room.

TABLE 22

FREQUENCY DISTRIBUTION TABLE OF CASES BY INDIVIDUAL OPERATING ROOM

OPERATING ROOM	FREQUENCY	PERCENTAGE
Room 1	150	20.52%
Room 2	52	7.11%
Room 3	178	24.35%
Room 4	99	13.54%
Room 5	77	10.53%
Room 6	105	14.36%
Room 8	70	9.58%
Total:	731	100%

The longest mean room turnover time was 26.65 minutes which was associated with operating room #2. Operating room #3 had the shortest mean time with 18.94 minutes

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TABLE 23

GROUP MEANS FOR ROOM TURNOVER BY INDIVIDUAL ROOM

OPERATING ROOM	MEAN	SD	n
Room 1	22.54	11.69	150
Room 2	26.65	13.15	52
Room 3	18.94	11.36	178
Room 4	24.66	11.64	99
Room 5	20.53	11.56	77
Room 6	22.03	11.28	105
Room 8	22.27	10.5	70

Table 24 depicts the results of the one-way ANOVA for Hypothesis 2 which stated that "operating room turnover varies as a function of group membership among the operating rooms within the surgical suite." The analysis resulted in a statistically significant F ratio of 4.64 which was notable at level 0.0001 ($F_{6,724} = 4.6357$, p = .0001). The null hypothesis was rejected. Statistically significant variation of room

turnover rates exist among the individual operating rooms within the surgical suite at Evans Army Community Hospital.

TABLE 24

ANOVA TABLE REFLECTING VARIANCE AMONG INDIVIDUAL OPERATING ROOMS

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	6	3698.999	616.4998	4.64	.0001
Within	724	96284.72	132.9899		
Total	730	99983.72			

In order to reduce the potential for committing a Type I error, Turkey's HSD post hoc test indicated significant differences among the following groups means: operating rooms 3 and 4, and operating rooms 3 and 2. Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test as significant in order to further scrutinize mean differences existing between the groups. Table 25 reports the findings for these independent samples *t* tests. The reported mean difference of room turnover time between operating rooms Number 3 and Number 4 was significant at $t_{(275)} = 3.98$, $p < .001$. The reported mean difference of room turnover time between operating rooms Number 2 and Number 3 was significant at $t_{(228)} = 4.15$, $p < .001$.

TABLE 25

ROOM TURNOVER BY ROOM
INDEPENDENT SAMPLES *t* TESTS
OF THOSE ROOMS IDENTIFIED BY
TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

ROOM	MEAN	SD	ROOM	MEAN	SD	*t*	p<=
Room 3	18.94	11.36	Room 4	24.66	11.64	3.98	0.001
Room 3	18.94	11.36	Room 2	26.65	13.15	4.15	0.001

Results of Procedure Time Variations

The same convenience sample of surgical cases used to construct procedure time probability tables was also used to determine variations involving procedural times. Table 26 breaks out the frequency of these cases by surgical service.

TABLE 26

FREQUENCY DISTRIBUTION TABLE
REFLECTING SURGICAL SERVICES

SERVICE	FREQUENCY	PERCENTAGE
General Surgery	634	20.78%
Orthopedic Surgery	690	22.62%
Ophthalmology	196	6.42%
Otorhinolaryngology	410	13.44%
Urology	262	8.59%
Obstetrics and Gynecology	629	20.62%
Oral Surgery	43	1.41%
Dental	23	0.75%
Podiatry	164	5.38%
Total:	3051	100%

Table 27 lists the descriptive statistics pertaining to procedure times among the various surgical services.

TABLE 27

DESCRIPTIVE STATISTICS OF
PROCEDURE TIMES BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	93.09	76.23	634
Orthopedic Surgery	81.02	53.19	690
Ophthalmology	59.64	37.77	196
Otorhinolaryngology	39.54	43.83	410
Urology	63.48	50.24	262
Obstetrics/Gynecology	56.41	40.05	629
Oral Surgery	131.53	84.83	43
Dental Services	84.43	32.70	23
Podiatry	61.81	28.97	164
Grand:	69.71	57.11	3051

Table 28 reflects the results of the one-way ANOVA used to test Hypothesis 3 which stated, "Procedure times measured from the first incision to the final closing suture varies as a function of group membership among the surgical services." The analysis resulted in a statistically significant F ratio of 48.68 which was significant at level 0.0001 ($F_{8,3042} = 46.68$, $p < .0001$). The null hypothesis was rejected. Procedure times vary significantly among surgical services.

TABLE 28

ANOVA TABLE REFLECTING VARIANCE
OF PROCEDURE TIMES AMONG INDIVIDUAL SURGICAL
SERVICES AT EVANS ARMY COMMUNITY HOSPITAL

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	8	1129106.6	141138.325	48.68	.0000
Within	3042	8819598.3	2899.276		
Total	3050	9948704.9			

Table 29 lists the pairs of services identified by Tukey's HSD as significant at level .05 when group means for Procedure Time were compared. Also reported are the results of the independent samples t tests which were conducted on the identified pairs. Procedure Time group means for otorhinolaryngology were significantly less when compared to obstetrics and gynecology ($t_{1037} = 6.39$, p = .000), ophthalmology ($t_{604} = 5.52$, p = .000), podiatry ($t_{572} = 6.00$, p = .000), urology ($t_{670} = 6.52$, p = .000), orthopedic surgery ($t_{1098} = 13.33$, p = .000), dental services ($t_{431} = 4.84$, p = .000), general surgery ($t_{1042} = 12.91$, p = .000) and oral surgery ($t_{451} = 11.69$, p = .000). Procedure Time group means for obstetrics and gynecology were significantly less when compared to orthopedic surgery ($t_{1317} = 9.42$, p = .000), general surgery ($t_{1261} = 10.70$, p = .000) and oral surgery ($t_{670} = 10.78$, p = .000). Procedure Time group means for ophthalmology were significantly less when compared to orthopedic surgery ($t_{884} = 5.26$, p = .000), general surgery ($t_{828} = 5.92$, p = .000) and oral surgery ($t_{237} = 8.63$, p = .000). Procedure Time group means for podiatry were significantly less when compared to orthopedic surgery ($t_{852} = 4.47$, p = .000), general surgery ($t_{796} = 5.16$, p = .000) and oral surgery ($t_{205} = 8.79$, p = .000). Procedure Time group means for urology were significantly less when compared to orthopedic surgery ($t_{950} = 5.61$, p = .000), general surgery ($t_{894} = 5.79$, p = .000) and oral surgery ($t_{303} = 7.34$, p = .000). Procedure Time group means for orthopedic surgery were significantly less when compared to general surgery ($t_{1322} = 3.36$, p = .001) and oral surgery ($t_{731} = 5.79$, p = .000). Procedure Time group means for dental services ($t_{64} = 2.56$, p = .013) and general surgery ($t_{675} = 3.18$, p = .002) were significantly less when

TABLE 29

INDEPENDENT SAMPLES t TESTS FOR PROCEDURE TIMES IDENTIFIED AS SIGNIFICANT BY TUKEY'S HSD

SERVICE1	MEAN	SD	SERVICE2	MEAN	SD	t	p <, =
Otorhinolaryngology	39.54	43.83	Obstetrics/Gynecology	56.41	40.05	6.39	0.001
Otorhinolaryngology	39.54	43.83	Ophthalmology	59.64	37.77	5.52	0.001
Otorhinolaryngology	39.54	43.83	Podiatry	61.81	28.97	6.00	0.001
Otorhinolaryngology	39.54	43.83	Urology	63.48	50.24	6.52	0.001
Otorhinolaryngology	39.54	43.83	Orthopedic Surgery	81.02	53.19	13.33	0.001
Otorhinolaryngology	39.54	43.83	Dental Services	84.43	32.70	4.84	0.001
Otorhinolaryngology	39.54	43.83	General Surgery	93.09	76.23	12.91	0.001
Otorhinolaryngology	39.54	43.83	Oral Surgery	131.53	84.83	11.69	0.001
Obstetrics/Gynecology	56.41	40.05	Orthopedic Surgery	81.02	53.19	9.42	0.001
Obstetrics/Gynecology	56.41	40.05	General Surgery	93.09	76.23	10.70	0.001
Obstetrics/Gynecology	56.41	40.05	Oral Surgery	131.53	84.83	10.78	0.001
Ophthalmology	59.64	37.77	Orthopedic Surgery	81.02	53.19	5.26	0.001
Ophthalmology	59.64	37.77	General Surgery	93.09	76.23	5.92	0.001
Ophthalmology	59.64	37.77	Oral Surgery	131.53	84.83	8.63	0.001
Podiatry	61.81	28.97	Orthopedic Surgery	81.02	53.19	4.47	0.001
Podiatry	61.81	28.97	General Surgery	93.09	76.23	5.16	0.001
Podiatry	61.81	28.97	Oral Surgery	131.53	84.83	8.79	0.001
Urology	63.48	50.24	Orthopedic Surgery	81.02	53.19	4.61	0.001
Urology	63.48	50.24	General Surgery	93.09	76.23	5.79	0.001
Urology	63.48	50.24	Oral Surgery	131.53	84.83	7.34	0.001
Orthopedic Surgery	81.02	53.19	General Surgery	93.09	76.23	3.36	0.001
Orthopedic Surgery	81.02	53.19	Oral Surgery	131.53	84.83	5.79	0.001
Dental Services	84.43	32.70	Oral Surgery	131.53	84.83	2.56	0.013
General Surgery	93.09	76.23	Oral Surgery	131.53	84.83	3.18	0.002

compared to oral surgery.

Table 30 reports descriptive statistics pertaining to anesthesia times among the various surgical services.

TABLE 30

DESCRIPTIVE STATISTICS
ANESTHESIA TIMES BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	145.46	87.16	634
Orthopedic Surgery	135.77	65.01	690
Ophthalmology	102.24	44.80	196
Otorhinolaryngology	75.58	60.96	410
Urology	114.86	68.94	262
Obstetrics/Gynecology	106.77	48.29	629
Oral Surgery	191.98	92.17	43
Dental Services	130.96	32.66	23
Podiatry	103.35	33.47	164
Grand:	118.78	69.51	3051

Table 31 reflects the results of the one-way ANOVA used to test Hypothesis 4 which stated, "Anesthesia time measured from induction to extubation varies as a function of group membership among the surgical services." The analysis resulted in a statistically significant F ratio of 54.14 which was significant at level 0.0001 ($F_{8,3042} = 54.143$, $p < .0001$). The null hypothesis was rejected. Anesthesia times vary significantly among surgical services at Evans Army Community Hospital.

TABLE 31

ANOVA TABLE REFLECTING VARIANCE
OF ANESTHESIA TIMES AMONG INDIVIDUAL SURGICAL
SERVICES AT EVANS ARMY COMMUNITY HOSPITAL

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	8	1836734.5	229591.8	54.143	.0000
Within	3042	12899537.5	4240.479		
Total	3050	14736271.99			

Table 32 lists the pairs of services identified by Tukey's HSD as significant at level .05 when group means for Anesthesia Time were compared. Also reported are the results of the independent samples *t* tests which were conducted on the identified pairs. Anesthesia Time group means for otorhinolaryngology were significantly less when compared to ophthalmology (t_{604} = 5.46, p = .000), podiatry (t_{572} = 5.51, p = .000), obstetrics and gynecology (t_{1037} = 9.16, p = .000), urology (t_{670} = 7.74, p = .000), dental services (t_{431} = 4.32, p = .000), orthopedic surgery (t_{1098} = 15.19, p = .000), general surgery (t_{1042} = 14.15, p = .000) and oral surgery (t_{451} = 11.26, p = .000). Anesthesia Time group means for ophthalmology were significantly less when compared to orthopedic surgery (t_{884} = 6.78, p = .000), general surgery (t_{634} = 6.67, p = .000) and oral surgery (t_{237} = 9.48, p = .000). Anesthesia Time group means for podiatry were significantly less when compared to orthopedic surgery (t_{852} = 6.19, p = .000), general surgery (t_{796} = 6.07, p = .000) and oral surgery (t_{205} = 10.09, p = .000). Anesthesia Time group means for obstetrics and gynecology were significantly less when compared to orthopedic surgery (t_{1317} = 9.13, p = .000), general surgery (t_{1261} = 9.75, p = .000) and oral surgery (t_{670} = 10.37, p = .000). Anesthesia Time group

TABLE 32

INDEPENDENT SAMPLES t TESTS FOR ANESTHESIA TIMES IDENTIFIED AS SIGNIFICANT BY TUKEY'S HSD

SERVICE1	MEAN	SD	SERVICE2	MEAN	SD	*t*	p <, =
Otorhinolaryngology	75.58	60.96	Ophthalmology	102.24	44.80	5.46	0.001
Otorhinolaryngology	75.58	60.96	Podiatry	103.35	33.47	5.51	0.001
Otorhinolaryngology	75.58	60.96	Obstetrics/Gynecology	106.77	48.29	9.16	0.001
Otorhinolaryngology	75.58	60.96	Urology	114.86	68.94	7.74	0.001
Otorhinolaryngology	75.58	60.96	Dental Services	130.96	32.66	4.32	0.001
Otorhinolaryngology	75.58	60.96	Orthopedic Surgery	135.77	65.01	15.19	0.001
Otorhinolaryngology	75.58	60.96	General Surgery	145.46	87.16	14.15	0.001
Otorhinolaryngology	75.58	60.96	Oral Surgery	191.98	92.17	11.26	0.001
Ophthalmology	102.24	44.80	Orthopedic Surgery	135.77	65.01	6.78	0.001
Ophthalmology	102.24	44.80	General Surgery	145.46	87.16	6.67	0.001
Ophthalmology	102.24	44.80	Oral Surgery	191.98	92.17	9.48	0.001
Podiatry	103.35	33.47	Orthopedic Surgery	135.77	65.01	6.19	0.001
Podiatry	103.35	33.47	General Surgery	145.46	87.16	6.07	0.001
Podiatry	103.35	33.47	Oral Surgery	191.98	92.17	10.09	0.001
Obstetrics/Gynecology	106.77	48.29	Orthopedic Surgery	135.77	65.01	9.13	0.001
Obstetrics/Gynecology	106.77	48.29	General Surgery	145.46	87.16	9.75	0.001
Obstetrics/Gynecology	106.77	48.29	Oral Surgery	191.98	92.17	10.37	0.001
Urology	114.86	68.94	Orthopedic Surgery	135.77	65.01	4.36	0.001
Urology	114.86	68.94	General Surgery	145.46	87.16	5.06	0.001
Urology	114.86	68.94	Oral Surgery	191.98	92.17	6.45	0.001
Dental Services	130.96	32.66	Oral Surgery	191.98	92.17	3.06	0.003
Orthopedic Surgery	135.77	65.01	Oral Surgery	191.98	92.17	5.35	0.001
General Surgery	145.46	87.16	Oral Surgery	191.98	92.17	3.37	0.001

means for urology were significantly less when compared to orthopedic surgery (t_{950} = 4.36, p = .000), general surgery (t_{894} = 5.06, p = .000) and oral surgery (t_{303} = 6.45, p = .000). Anesthesia Time group means for dental services (t_{64} = 3.06, p = .003), orthopedic surgery (t_{731} = 5.35, p = .000) and general surgery (t_{675} = 3.37, p = .001) were significantly less when compared to oral surgery.

Table 33 lists the descriptive statistics associated with Delta Times among the various surgical services. Delta Time was defined as Total Room Time minus Procedure Time.

TABLE 33

DESCRIPTIVE STATISTICS
DELTA TIMES BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	56.87	28.49	634
Orthopedic Surgery	60.43	34.63	690
Ophthalmology	44.65	17.97	196
Otorhinolaryngology	39.49	23.59	410
Urology	55.08	32.33	262
Obstetrics/Gynecology	54.25	31.17	629
Oral Surgery	66.16	29.39	43
Dental Services	53.57	17.38	23
Podiatry	48.19	21.91	164
Grand:	53.50	30.21	3051

Table 34 reflects the results of the one-way ANOVA used to test Hypothesis 5 which stated, "The amount of elapsed time measured by the difference between the total room time and the procedure time (Delta Time) varies as a function of group membership among the surgical services." The analysis resulted in a statistically significant F ratio of 21.46 which was significant at level 0.0001 ($F_{8,3042}$ = 21.46, p <

.0001). The null hypothesis was rejected. The Delta Time among all procedures varies significantly among the various surgical services.

TABLE 34

ANOVA TABLE REFLECTING VARIANCE OF DELTA ROOM TIMES AMONG INDIVIDUAL SURGICAL SERVICES AT EVANS ARMY COMMUNITY HOSPITAL

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	8	148717.93	18589.74	21.46	.0000
Within	3042	2634916.82	866.179		
Total	3050	2783634.75			

Table 35 lists the pairs of services identified by Tukey's HSD as significant at level .05 when group means for Delta Time were compared. Also reported are the results of the independent samples *t* tests which were conducted on the identified pairs.

Delta Time group means for otorhinolaryngology were significantly less when compared to podiatry (t_{572} = 4.07, p = .000), obstetrics and gynecology (t_{1037} = 8.18, p = .000), urology (t_{670} = 7.21, p = .000), general surgery (t_{1042} = 10.28, p = .000), orthopedic surgery (t_{1098} = 10.84, p = .000) and oral surgery (t_{451} = 6.88, p = .000).

Delta Time group means for ophthalmology were significantly less when compared to obstetrics and gynecology (t_{823} = 4.10, p = .000), urology (t_{456} = 4.07, p = .000), general surgery (t_{828} = 5.66, p = .000), orthopedic surgery (t_{884} = 6.15, p = .000) and oral surgery (t_{237} = 6.24, p = .000). Podiatry was significantly less when compared to general surgery (t_{796} = 3.63, p = .000), orthopedic surgery (t_{852} = 4.33, p = .000) and oral surgery (t_{205} = 4.44, p = .000). The Delta Time group mean for

TABLE 35

DELTA (TOTAL ROOM TIME MINUS PROCEDURE TIME)
INDEPENDENT SAMPLES *t* TESTS FOR THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	*t*	p<=
Otorhinolaryngology	39.49	23.59	Podiatry	48.19	21.91	4.07	0.001
Otorhinolaryngology	39.49	23.59	Obstetrics/Gynecology	54.25	31.17	8.18	0.001
Otorhinolaryngology	39.49	23.59	Urology	55.08	32.33	7.21	0.001
Otorhinolaryngology	39.49	23.59	General Surgery	56.87	28.49	10.28	0.001
Otorhinolaryngology	39.49	23.59	Orthopedic Surgery	60.43	34.63	10.84	0.001
Otorhinolaryngology	39.49	23.59	Oral Surgery	66.16	29.39	6.88	0.001
Ophthalmology	44.65	17.97	Obstetrics/Gynecology	54.25	31.17	4.10	0.001
Ophthalmology	44.65	17.97	Urology	55.08	32.33	4.07	0.001
Ophthalmology	44.65	17.97	General Surgery	56.87	28.49	5.66	0.001
Ophthalmology	44.65	17.97	Orthopedic Surgery	60.43	34.63	6.15	0.001
Ophthalmology	44.65	17.97	Oral Surgery	66.16	29.39	6.24	0.001
Podiatry	48.19	21.91	General Surgery	56.87	28.49	3.63	0.001
Podiatry	48.19	21.91	Orthopedic Surgery	60.43	34.63	4.33	0.001
Podiatry	48.19	21.91	Oral Surgery	66.16	29.39	4.44	0.001
Obstetrics/Gynecology	54.25	31.17	Orthopedic Surgery	60.43	34.63	3.40	0.001

obstetrics and gynecology was significantly less from the group mean of orthopedic surgery ($t_{1317} = 3.40$, p = .001).

Results of Operating Room Starts

To examine nursing start times, a convenience sample of 499 surgical cases were reviewed to determine whether they started at the time they were scheduled or later. Each case that was examined represented the first scheduled case for that day in each available room from September 1, 1995 to March 20, 1996. Table 36 depicts the frequencies of surgical cases by individual service.

TABLE 36

FREQUENCY DISTRIBUTION TABLE
REFLECTING SURGICAL SERVICES

SERVICE	FREQUENCY	PERCENTAGE
General Surgery	98	19.64%
Orthopedic Surgery	126	25.25%
Ophthalmology	36	7.21%
Otorhinolaryngology	69	13.83%
Urology	48	9.62%
Obstetrics and Gynecology	69	13.83%
Oral Surgery	17	3.41%
Dental	9	1.80%
Podiatry	27	5.41%
Total:	499	100%

Of the sample, 120 cases (24 percent) were exactly on time. The remaining 379 cases (76 percent) were defined as late, ranging from 3 minutes past the scheduled start time to 450 minutes past the scheduled start. The mean elapsed time from the scheduled start to the actual start was 46.08 minutes with a standard deviation of 66.62 minutes (n = 379). Of those cases identified as late, 152 (40.11 percent) were within 30 minutes of their scheduled start time. This means that 272 surgical procedures (54.5 percent) from the convenience sample of 499 either started on time or within 30 minutes of their scheduled start time. The remaining 227 surgical cases (45.5 percent) fell outside of the 30 minute window.

Hypothesis 6 which stated that "the actual rate of late starts occurring in the operating room varies significantly from the expected rate among surgical services" was tested using chi-square analysis. The results were not significant with a Pearson value of 12.45 yielding a significance level of 0.13 ($X^2 = 12.452$, df = 8, p = .13215).

The null hypothesis was accepted. Table 37 portrays the crosstabs analysis for this hypothesis.

TABLE 37

CROSSTABS ANALYSIS DEPICTING
LATE STARTS BY SURGICAL SERVICE

SERVICE	NOT LATE	LATE	ROW TOTAL
General Surgery	28	70	98
Orthopedic Surgery	30	96	126
Ophthalmology	11	25	36
Otorhinolaryngology	14	55	69
Urology	9	39	48
Obstetrics and Gynecology	12	57	69
Oral Surgery	2	15	17
Dental Services	2	7	9
Podiatry	12	15	27
Column Total:	120	379	499

Hypothesis 7 which stated that "the actual rate of late starts occurring in the operating room varies significantly from the expected rate among individual operating rooms" was tested using chi-square analysis. The results were not significant with a Pearson value of 1.63 yielding a significance level of 0.95 ($X^2 = 1.62795$, df = 6, p = .95055). The null hypothesis was accepted. Table 38 portrays the crosstabs analysis for this hypothesis.

TABLE 38

CROSSTABS ANALYSIS DEPICTING
LATE STARTS BY OPERATING ROOM

OPERATING ROOM	NOT LATE	LATE	ROW TOTAL
Room 1	28	76	104
Room 2	12	49	61
Room 3	18	59	77
Room 4	21	72	93
Room 5	12	40	52
Room 6	20	54	74
Room 8	9	29	38
Column Total:	120	379	499

To examine surgeon start times, a convenience sample of 3,042 surgical cases from June 1, 1995 to March 21, 1996 were reviewed to determined the amount of time that typically elapses from the time a patient enters a room until the first incision. Table 39 depicts the frequencies of surgical cases by individual service.

TABLE 39

DESCRIPTIVE STATISTICS
"TO PROCEDURE" TIMES BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	34.06	19.50	630
Orthopedic Surgery	37.99	20.39	691
Ophthalmology	26.42	13.10	196
Otorhinolaryngology	19.26	14.47	409
Urology	30.64	15.03	260
Obstetrics/Gynecology	31.97	17.30	626
Oral Surgery	35.84	20.26	43
Dental Services	31.35	16.01	23
Podiatry	24.88	13.93	164
Grand:	31.26	18.61	3042

Table 40 depicts the results of the one-way ANOVA for Hypothesis 8 which stated that "the duration between the time a patient arrives in the room and the time of the first incision (To Procedure) varies as a function of group membership among the

surgical services." The analysis resulted in a statistically significant F ratio of 43.2 which was notable at level 0.0001 ($F_{8,3033} = 43.2157$, $p < .0001$). The null hypothesis was rejected. Statistically significant variation of the elapsed time between patient entry and first incision (To Procedure) exists among the individual surgical services at Evans Army Community Hospital.

TABLE 40

ANOVA TABLE REFLECTING VARIANCE AMONG THE INDIVIDUAL SURGICAL SERVICES WITH "TO PROCEDURE TIME"

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	8	107723.3473	13465.4184	43.216	.0000
Within	3033	945041.9719	311.5865		
Total	3041	1052765.319			

Table 41 lists the pairs of services identified by Tukey's HSD as significant at level .05 when group means for To Procedure times were compared. Also reported are the results of the independent samples *t* tests which were conducted on the identified pairs. The To Procedure group means for otorhinolaryngology were significantly less when compared to podiatry ($t_{571} = 4.25$, $p = .000$), ophthalmology ($t_{603} = 5.87$, $p = .000$), urology ($t_{667} = 9.77$, $p = .000$), dental services ($t_{430} = 3.88$, $p = .000$), obstetrics and gynecology ($t_{1033} = 12.31$, $p = .000$), general surgery ($t_{1037} = 13.18$, $p = .000$), oral surgery ($t_{450} = 6.85$, $p = .000$) and orthopedic surgery ($t_{1098} = 16.30$, $p = .000$). To Procedure group means for podiatry were significantly less when compared to urology ($t_{422} = 3.95$, $p = .000$), obstetrics and gynecology ($t_{788} = 4.85$, p

= .000), general surgery (t_{792} = 5.66, p = .000), oral surgery (t_{205} = 4.14, p = .000) and orthopedic surgery (t_{853} = 7.81, p = .000). To Procedure group means for ophthalmology were significantly less when compared to obstetrics and gynecology (t_{820} = 4.14, p = .000), general surgery (t_{824} = 5.14, p = .000), oral surgery (t_{237} = 3.82, p = .000) and orthopedic surgery (t_{885} = 7.51, p = .000). To Procedure group means for urology (t_{949} = 5.29, p = .000), obstetrics and gynecology (t_{1315} = 5.74, p = .000) and general surgery (t_{1319} = 3.57, p = .000) were significantly less when compared to orthopedic surgery.

TABLE 41

"TO PROCEDURE" TIMES
INDEPENDENT SAMPLES *t* TESTS FOR THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE1	MEAN	SD	SERVICE2	MEAN	SD	*t*	p <
Otorhinolaryngology	19.26	14.47	Podiatry	24.88	13.93	4.25	0.001
Otorhinolaryngology	19.26	14.47	Ophthalmology	26.42	13.10	5.87	0.001
Otorhinolaryngology	19.26	14.47	Urology	30.64	15.03	9.77	0.001
Otorhinolaryngology	19.26	14.47	Dental Services	31.35	16.01	3.88	0.001
Otorhinolaryngology	19.26	14.47	Obstetrics/Gynecology	31.97	17.30	12.31	0.001
Otorhinolaryngology	19.26	14.47	General Surgery	34.06	19.50	13.18	0.001
Otorhinolaryngology	19.26	14.47	Oral Surgery	35.84	20.26	6.85	0.001
Otorhinolaryngology	19.26	14.47	Orthopedic Surgery	37.99	20.39	16.3	0.001
Podiatry	24.88	13.93	Urology	30.64	15.03	3.95	0.001
Podiatry	24.88	13.93	Obstetrics/Gynecology	31.97	17.30	4.85	0.001
Podiatry	24.88	13.93	General Surgery	34.06	19.50	5.66	0.001
Podiatry	24.88	13.93	Oral Surgery	35.84	20.26	4.14	0.001
Podiatry	24.88	13.93	Orthopedic Surgery	37.99	20.39	7.81	0.001
Ophthalmology	26.42	13.10	Obstetrics/Gynecology	31.97	17.30	4.14	0.001
Ophthalmology	26.42	13.10	General Surgery	34.06	19.50	5.14	0.001
Ophthalmology	26.42	13.10	Oral Surgery	35.84	20.26	3.82	0.001
Ophthalmology	26.42	13.10	Orthopedic Surgery	37.99	20.39	7.51	0.001
Urology	30.64	15.03	Orthopedic Surgery	37.99	20.39	5.29	0.001
Obstetrics/Gynecology	31.97	17.30	Orthopedic Surgery	37.99	20.39	5.74	0.001
General Surgery	34.06	19.50	Orthopedic Surgery	37.99	20.39	3.57	0.001

Results of Delays Occurring in the Operating Room

Beginning on January 16, 1996 and ending on March 21, 1996, operating room nurses at Evans Army Community Hospital focused on delays occurring in the operating room. A convenience sample of 779 surgical cases were observed by the nurses, and a total of 136 or 17.5 percent of cases experienced observed delays. Of the 136 surgical cases, 19 experienced two delays resulting in a total of 155 observed delays.

The operating nurses serving as observers estimated that a total of 2,575 minutes were consumed by delays occurring in the operating room during the sixty-six day observation period. This equates to 42.92 hours or 5.36 work days of squandered resources. Table 42 below depicts the number of observed cases experiencing delays by individual surgical services during the observation period.

TABLE 42

FREQUENCY DISTRIBUTION OF OBSERVED CASES AND DELAYS

SURGICAL SERVICE	OBSERVED CASES	% CASES	OBSERVED CASES WITH DELAYS	% DELAYS
General Surgery	139	17.84%	35	25.74%
Orthopedic Surgery	162	20.80%	31	22.79%
Ophthalmology	42	5.39%	11	8.09%
Otorhinolaryngology	144	18.49%	13	9.56%
Urology	76	9.76%	11	8.09%
Obstetrics and Gynecology	136	17.46%	21	15.44%
Oral Surgery	11	1.41%	3	2.21%
Dental Services	5	0.64%	1	0.74%
Podiatry	64	8.22%	10	7.35%
Totals:	779	100%	136	100%

Delays were coded and organized into five major constructs: environmental factors, personnel factors, information factors, patient factors and equipment/supply factors. Tables 43 through 47 depict the frequency of delays occurring within each

TABLE 43

FREQUENCY DISTRIBUTION OF DELAYS
CAUSED BY ENVIRONMENTAL FACTORS

DELAY	FREQUENCY	PERCENTAGE
Add-on case	1	5.88%
Case postponed/canceled	1	5.88%
Contaminated room	0	0.00%
Delay from patient care unit	8	47.06%
Elevators not available	0	0.00%
Order of cases rearranged	4	23.53%
OR being cleaned, set up	3	17.65%
Total:	17	100%

construct or domain. Personnel factors accounted for the majority of delays occurring within the operating room with a total of 59 observed delays. Environmental factors accounted for the least with 17 observed delays. Figure 4 illustrates the frequency of delays by each construct in the form of a Pareto Chart.

Table 44 below delineates those delays caused by personnel factors. A total of 59 observed delays, or 38.06 percent of the total number of observed delays, occurred within this domain. Of the 59 observed delays, 40 (67.8 percent) are attributed to the unavailablility of the assigned surgeon. The unavailability of the anesthesiologist or nurse anesthetist accounted for 11 (18.64 percent) observed delays.

Table 45 depicts frequencies of delays occurring within the information construct. A total of 23 observed delays, or 14.84 percent of the total number of

delays, occurred within this domain. Of the delays caused by information factors, the most significant was the exclusion of the patient's history and physical exam from the

TABLE 44

FREQUENCY DISTRIBUTION OF DELAYS
CAUSED BY PERSONNEL FACTORS

DELAY	FREQUENCY	PERCENTAGE
Anesthesia not available	11	18.64%
Escort not available	0	0.00%
Housekeeping not available	1	1.69%
OR nurse not available	2	3.39%
Surgeon not available	40	67.80%
X-ray not available	1	1.69%
OR technician not available	4	6.78%
Total:	59	100%

chart. A total of 15 (65.22 percent) observed delays within the information domain were directly attributable to this particular oversight. The apparent lack of documentation pertaining to the informed consent of the surgical procedure was the second most frequent cause for delay within this construct.

TABLE 45

FREQUENCY DISTRIBUTION OF DELAYS
CAUSED BY INFORMATION FACTORS

DELAY	FREQUENCY	PERCENTAGE
Abnormal laboratory results	0	0.00%
Additional x-rays needed	2	8.70%
Anesthesia assessment not completed	1	4.35%
Chart not completed	0	0.00%
Chart being reviewed	0	0.00%
Consent not signed	3	13.04%
Consult not completed	0	0.00%
History and Physical not on chart	15	65.22%
Repeat blood work needed	0	0.00%
Results from Pathology not available	0	0.00%
Test results not on chart	2	8.70%
Writing orders	0	0.00%
Total:	23	100%

Table 46 lists frequencies of observed delays within the patient construct. A total of 26 observed delays, or 16.77 percent of the total number of observed delays, occurred within this construct. The frequency of delays occurring within this particular domain was spread more evenly than the others. The unavailability of the patient accounted for 7 (26.92 percent) of the delays occurring due to individual patient factors. The patient's physical condition accounted the second most frequent occurrences within this domain with an observed count of 4 (15.38 percent) delays. A failed regional technique, time spent repositioning the patient and time spent generating additional intravenous/monitoring lines accounted for 3 (11.54 percent) delays each. Difficult intravenous access and difficult regional techniques accounted for the remaining four delays occurring within this domain.

TABLE 46

FREQUENCY DISTRIBUTION OF DELAYS
CAUSED BY PATIENT FACTORS

DELAY	FREQUENCY	PERCENTAGE
Additional IVs, monitoring lines needed	3	11.54%
Additional procedures performed	1	3.85%
Difficult intubation	1	3.85%
Difficult IV access	2	7.69%
Failed regional technique	3	11.54%
Nail polish needs removal	0	0.00%
Patient not available	7	26.92%
Patient being repositioned	3	11.54%
Patient's condition	4	15.38%
Difficult regional technique	2	7.69%
Total:	26	100%

Table 47 depicts those delays occurring within the equipment/supply construct. Delays occurring within this domain accounted for 30 observed delays, 19.35 percent

of the total observed delays. The requirement for additional equipment and supplies accounted for over 43 percent of the observed delays occurring within this domain. The unavailablility of additional and routine equipment and instruments accounted for 30 percent of the observed delays.

TABLE 47

FREQUENCY DISTRIBUTION OF DELAYS
CAUSED BY EQUIPMENT/SUPPLY FACTORS

DELAY	FREQUENCY	PERCENTAGE
Additional equipment needed	7	23.33%
Additional instruments needed	1	3.33%
Additional supplies needed	6	20.00%
Additional equipment not available	1	3.33%
Additional instruments not available	2	6.67%
Additional supplies not available	0	0.00%
Blood, blood products not available	0	0.00%
Drapes/instruments contaminated	0	0.00%
Equipment not functioning	2	6.67%
Instruments not functioning	1	3.33%
Lost suture	0	0.00%
Transport bed late	0	0.00%
Transport oxygen, ambu bag not available	0	0.00%
Routine equipment not available	5	16.67%
Routine instruments not available	4	13.33%
Routine supplies not available	1	3.33%
Total:	30	100%

Figure 4 is a Pareto Chart which illustrates the frequency of observed delays within each construct in descending order. Personnel factors were most frequent in causing delays followed by equipment/supplies, the patient, information and finally the environment.

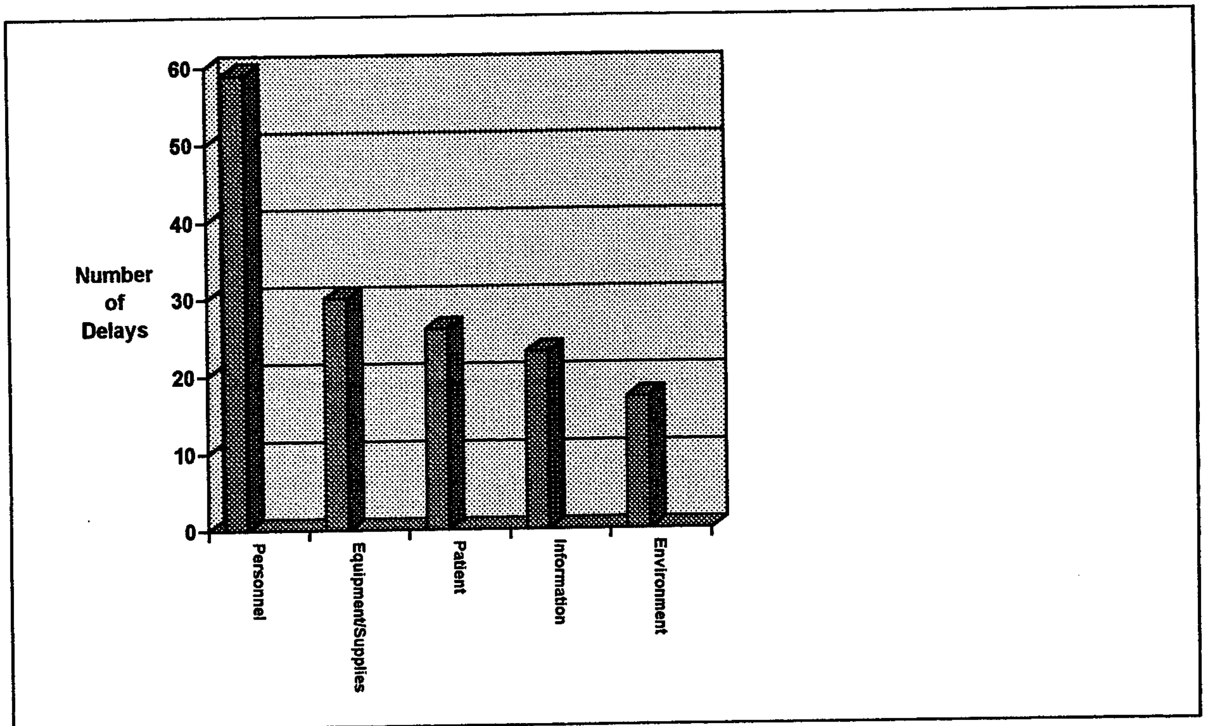

Fig. 4. Pareto Chart depicting frequency of observed delays within the five constructs of personnel, equipment/supplies, patient, information and environment.

A one-way ANOVA was used to test Hypothesis 9 which stated that "the time consumed with delays occurring within the operating room varies as a function of group membership among the surgical services." Table 48 below reports the findings. An F ratio of 1.14 which was significant at the 0.3329 level ($F_{8,770} = 1.14$, $p > .05$) indicates with relatively high certainty that any variance between surgical services was due to chance. In this case, the one-way ANOVA failed to produce statistically significant results, and the null hypothesis was accepted. Any variance among the individual surgical services involving time wasted by observed delays in the operating room are more than likely coincidental.

A chi-square analysis was used to test Hypothesis 10 which stated that "the actual rate of case delay occurrences within the operating rooms varies significantly

from the expected rate among the surgical services." The expected rate of delays was set at 17.5 percent which was the overall observed rate reported by the operating room nurses.

TABLE 48

ANOVA TABLE REFLECTING VARIANCE OF DELAY TIME CONSUMED AMONG THE SURGICAL SERVICES

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	8	792.56	333.74	1.14	.3329
Within	770	66838.72	93.81		
Total	778	67631.29			

The chi-square analysis was statistically significant with a Pearson value of 17.15 and a probability of 0.02856 ($X^2 = 17.15$, df = 8, $p < .05$). The null hypothesis was rejected. The rate of delay occurrences among the surgical services vary significantly from the expected rate of occurrences. Table 49 outlines the crosstabs table depicting the observed and expected values for each surgical service.

TABLE 49

CROSSTABS ANALYSIS OF DELAYS BY SERVICE

Count
Expected Value
Row %
Column %
Total %

Surgical Service	No Delay	Delay	Row Total
General Surgery	104	35	139
	114.675	24.325	17.84%
	74.82%	25.18%	
	16.17%	25.74%	
	13.35%	4.49%	
Orthopedic Surgery	131	31	162
	133.7	28.35	20.80%
	80.86%	19.14%	
	20.37%	22.79%	
	16.82%	3.98%	
Ophthalmology	31	11	42
	34.65	7.35	5.39%
	73.81%	26.19%	
	4.82%	8.09%	
	3.98%	1.41%	
Otorhinolaryngology	131	13	144
	118.8	25.2	18.49%
	90.97%	9.03%	
	20.37%	9.56%	
	16.82%	1.67%	
Urology	65	11	76
	62.7	13.3	9.76%
	85.53%	14.47%	
	10.11%	8.09%	
	8.34%	1.41%	
Obstetrics and Gynecology	115	21	136
	112.2	23.8	17.46%
	84.56%	15.44%	
	17.88%	15.44%	
	14.76%	2.70%	
Oral Surgery	8	3	11
	9.075	1.925	1.41%
	72.73%	27.27%	
	1.24%	2.21%	
	1.03%	0.39%	
Dental Services	4	1	5
	4.125	0.875	0.64%
	80.00%	20.00%	
	0.62%	0.74%	
	0.51%	0.13%	
Podiatry	54	10	64
	52.8	11.2	8.22%
	84.38%	15.63%	
	8.40%	7.35%	
	6.93%	1.28%	
Column Totals:	643	136	779
Column %:	82.54%	17.46%	100%

Results of Surgical Cancellations

Table 50 depicts the surgical case cancellations experienced at Evans Army Community Hospital from October 1995 to April 1996. Of 2,242 surgical cases, there were a total of 177 cancellations which comprised 7.89 percent of the total number of cases.

Of the 26 codes being measured, five resulted in frequencies of 10 or more. The most frequent cancellation code was "Patient Ill" which accounted for 47 cancellations during the period. Patients changed their minds about undergoing surgery 29 times during the period. Physicians determined that patients required further evaluation before undergoing surgery 20 times during the period. Surgeons were unavailable at the time of the scheduled surgery a total of 12 times. Patients simply did not show up on the date of surgery 10 times during this period.

Of the 5 domains, patients accounted for 102 of the cancellations that occurred. Surgeons directly influenced 62 case cancellations during this period. Nine cancellations resulted from administrative oversights. The operating room caused 1 cancellation, and 3 cases were canceled for unknown reasons. Figure 5 graphically displays this information in the form of a pie chart.

TABLE 50

CANCELLATION RATES
OCT 95 TO APR 96

	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	TOTAL	% of Cases	% of Cancellations
Total Cases	344	329	234	358	330	286	361	2242		
Clerical Error				3		1	5	9	0.40%	5.08%
Cancellation Reason Unknown	1		1	1				3	0.13%	1.69%
Abnormal Lab, X-ray, EKG		1		1	1	2	2	7	0.31%	3.95%
Done as an Emergency		1					3	4	0.18%	2.26%
Doctor Emergency Leave								0	0.00%	0.00%
Need Further Evaluation	2		3	1	2	5	7	20	0.89%	11.30%
Doctor Ill/Injured	2	3						5	0.22%	2.82%
Medical Complication				1	1	1	2	5	0.22%	2.82%
No Explanation Given	2	1		1				4	0.18%	2.26%
Surgery Not Needed Now							1	1	0.04%	0.56%
Surgeon, Other	1							1	0.04%	0.56%
MD Overbooked				3			4	7	0.31%	3.95%
Surgeon Unavailable							12	12	0.54%	6.78%
OR Equipment Unavailable		1						1	0.04%	0.56%
Patient AWOL								0	0.00%	0.00%
Patient Changed Mind	1	1	1	5	5	7	9	29	1.29%	16.38%
Patient Done in Clinic								0	0.00%	0.00%
Patient Deployed	1							1	0.04%	0.56%
Patient on Emergency Leave								0	0.00%	0.00%
Patient No Show			4	6				10	0.45%	5.65%
Patient Not NPO			1					1	0.04%	0.56%
Patient Other	1		2					3	0.13%	1.69%
Patient Pregnant		2		2			1	5	0.22%	2.82%
Patient Refuses Surgery						1	1	2	0.09%	1.13%
Patient Ill	5	12	4	11	2	4	9	47	2.10%	26.55%
Patient Not Authorized Care								0	0.00%	0.00%
TOTALS:	16	22	16	35	11	21	56	177	7.89%	

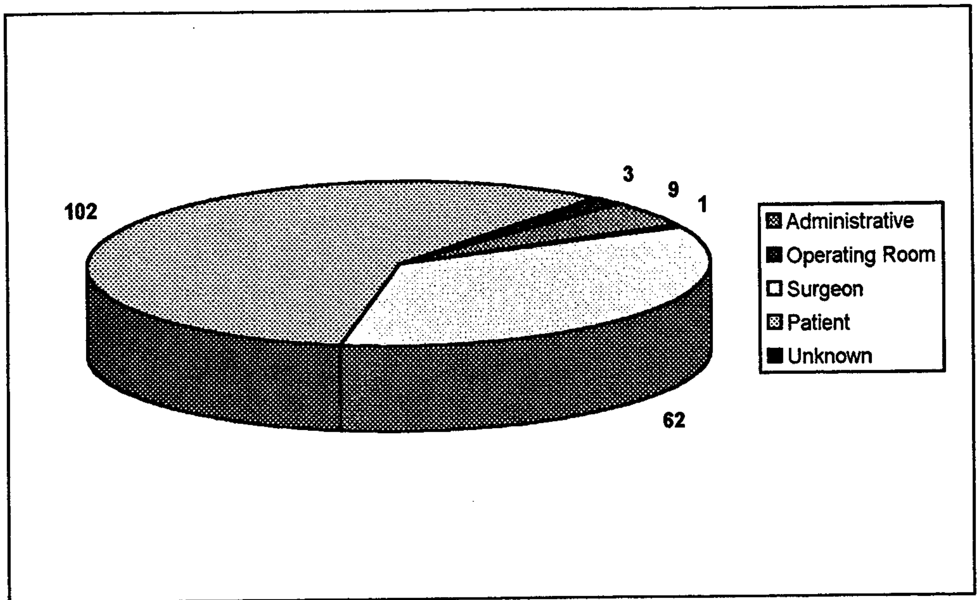

Fig. 5 Pie Chart Depicting Cancellations by Domain

Results of Patient Satisfaction

During a two month period from January 16, 1996 to March 15, 1996 a total of 164 patients presenting for post-surgical follow-up care responded to the Forbes-Brown questionnaire. Table 51 outlines the frequency of respondents among beneficiary categories. Of the 164 respondents, 51.83 percent (85 patients) were active duty soldiers and their family members. Retirees and their family members made up 44.51 percent (73 patients) of the respondents. The remaining respondents were comprised of 5 survivors and one patient who marked "Other" on the instrument. Males comprised 58.5 percent (96 patients) and females made up the remaining 41.5 percent (68 patients). The mean age of the respondents was 43.49 years. Parents completed 10 questionnaires for their children who were too young to complete the instrument. The respondents within this convenient sample do not adequately reflect the population of eligible beneficiaries within the hospital's catchment area.

TABLE 51

BENEFICIARY STATUS OF SURVEY RESPONDENTS

BENEFICIARY CATEGORY	FREQUENCY	PERCENTAGE
Active Duty	56	34.15%
Family Member of Active Duty	29	17.68%
Retiree	39	23.78%
Family Member of Retiree	34	20.73%
Survivor	5	3.05%
Other	1	0.61%

Table 52 depicts the frequency of responses from individual surgical services. With the exception of the urology service, response rates were fairly even throughout the participating clinics. The head nurse for the urology service refused to wholeheartedly support this study, and the response rate reflects that attitude. They are included at the request of the surgical service chief.

TABLE 52

CLINICS VISITED BY RESPONDENTS

CLINIC	FREQUENCY	PERCENTAGE
General Surgery	38	23.17%
Orthopedic Surgery	41	25.00%
Ophthalmology	43	26.22%
Otorhinolaryngology	34	20.73%
Urology	8	4.88%

Twenty questions were asked using a five-point Likert scale to measure patient perceptions concerning the caring attitudes of providers and staff, levels of patient/family education which occurred during the surgical process, the competence of the provider and the continuity of care. The questions were scored using the following methodology: strongly agree = 1; agree = 2; neutral = 3; disagree = 4; and

strongly disagree = 5. In this case, lower is better. Patient satisfaction was interpreted to be highest when scores were closest to 1 and lowest as scores neared the number 5.

TABLE 53

DESCRIPTIVE STATISTICS FOR INDIVIDUAL QUESTIONS FROM THE MODIFIED FORBES-BROWN INSTRUMENT

Question	Mean	Std Dev	Min	Max
"I was treated with respect."	1.27	.51	1	3
"My family was treated with respect."	1.44	.73	1	5
"The nurses listened to me."	1.36	.56	1	4
"The nurses met my needs without my asking."	1.48	.70	1	4
"The nurses showed concern for my comfort."	1.35	.59	1	4
"The nurses showed concern for the comfort of my family."	1.59	.72	1	4
"I received information about each procedure before surgery."	1.35	.57	1	4
"The nurses were confident in their abilities to provide care."	1.34	.56	1	3
"I received information about each procedure after surgery."	1.46	.72	1	5
"Before surgery, the nurses explained to me what I needed to know."	1.38	.58	1	4
After surgery, the nurses explained to me what I needed to know."	1.46	.70	1	5
"My questions were answered by the nurses."	1.40	.59	1	4
"I was prepared to care for myself because of the instructions I received."	1.49	.76	1	5
"My family was included in the instructions I received."	1.74	.95	1	5
"I understood each procedure as it was explained to me."	1.40	.58	1	4
"My fears were reduced before surgery due to the explanations given to me."	1.56	.80	1	5
"The explanations given by the nurses decreased my fears after surgery."	1.60	.83	1	5
"The nurses explained how I could relieve pain after I went home."	1.60	.85	1	5
"My recovery after surgery was easier because of the instructions I received."	1.60	.81	1	5
"The nurses asked if I understood the information given to me."	1.37	.52	1	3

Table 53 provides an analysis of the aggregate descriptive findings associated with each question.

Table 54 depicts the descriptive statistics pertaining to the major constructs of the instrument as well as the construct reliability associated with the instrument. "Total satisfaction" represents the mean score for the sum of the twenty items. The possible range for "total satisfaction" was 20 to 100. The variable, "caring," is measured by summing the six items within the instrument. The possible range for this variable is 6 to 30. The variable "continuity of care" was measured using four questions from the instrument and had a possible range of 4 to 20. The variables "competence" and "education of patients/family" were each measured by summing five items from the survey. Both constructs had possible ranges of 5 to 25. Reliability measures of each construct were conducted using Cronbach's alpha. Each construct demonstrated high levels of reliability.

TABLE 54

DESCRIPTIVE STATISTICS AND RELIABILITY MEASURES PERTAINING TO THE MAJOR CONSTRUCTS

CONSTRUCT	MEAN	SD	# OF ITEMS	ALPHA	n
Total Satisfaction	29.24	10.76	20	0.965	164
Caring	8.49	3.13	6	0.898	164
Continuity of Care	5.65	2.29	4	0.895	164
Competency	7.29	3.02	5	0.908	164
Education of Patient/Family	7.71	3.09	5	0.872	164

Table 55 provides the mean scores for Total Satisfaction by individual surgical service. The ophthalmology service received the lowest mean score for Total

Satisfaction while the general surgery service received the highest. Possible ranges for Total Satisfaction was 20 to 100.

TABLE 55

DESCRIPTIVE STATISTICS
TOTAL SATISFACTION BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	37.37	10.91	38
Orthopedic Surgery	31.90	11.63	41
Ophthalmology	22.51	4.89	43
Otorhinolaryngology	25.35	7.75	34
Urology	29.63	11.33	8

Table 56 provides mean scores for Caring by individual surgical service. The ophthalmology service received the lowest mean score within this construct while the general surgery service received the highest. The possible range of scores for this construct was 6 to 30.

TABLE 56

DESCRIPTIVE STATISTICS
"CARING" BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	10.53	3.25	38
Orthopedic Surgery	9.00	3.17	41
Ophthalmology	6.74	1.60	43
Otorhinolaryngology	7.94	3.22	34
Urology	8.00	2.56	8

Table 57 provides the mean scores for the construct, Continuity of Care, by individual surgical service. The ophthalmology service scored the best in this construct while the general surgery service scored less optimally. The possible range for this construct was 4 to 20.

TABLE 57

DESCRIPTIVE STATISTICS
"CONTINUITY OF CARE" BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	7.21	2.41	38
Orthopedic Surgery	6.17	2.68	41
Ophthalmology	4.44	1.05	43
Otorhinolaryngology	4.68	1.25	34
Urology	6.13	2.75	8

Table 58 provides the mean scores for the construct, Competence, by individual surgical service. Respondents rated the ophthalmology service highest in this construct and the general surgery service significantly lower. The possible range for this construct was 5 to 25.

TABLE 58

DESCRIPTIVE STATISTICS
"COMPETENCE" BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	9.74	3.13	38
Orthopedic Surgery	8.17	3.16	41
Ophthalmology	5.47	1.20	43
Otorhinolaryngology	6.18	1.99	34
Urology	7.75	3.45	8

Table 59 provides mean scores for the construct, Patient and Family Education, by individual surgical service. Respondents rated the ophthalmology service highest in this construct and the general surgery service lowest. The possible range for this construct was 5 to 25.

TABLE 59

DESCRIPTIVE STATISTICS
"EDUCATION" BY SURGICAL SERVICE

SURGICAL SERVICE	MEAN	SD	n
General Surgery	9.89	3.08	38
Orthopedic Surgery	8.56	3.41	41
Ophthalmology	5.86	1.64	43
Otorhinolaryngology	6.56	2.13	34
Urology	7.75	3.20	8

Table 60 provides a list of the hypotheses tested using one-way ANOVA to examine differences of means among the surgical service groups. Tukey's HSD test was used as a post hoc test to reduce the risk of committing Type I errors. Multiple *t* tests on independent samples were than calculated on those groups identified by Tukey's HSD test as being significantly different.

TABLE 60

LIST OF HYPOTHESES TESTED USING ONE-WAY ANOVA

Hypothesis 11: The total score for satisfaction varies as a function of group membership among the surgical services.
Hypothesis 12: The total score for "caring" varies as a function of group membership among the surgical services.
Hypothesis 13: The total score for "competence" varies as a function of group membership among the surgical services.
Hypothesis 14: The total score for "continuity of care" varies as a function of group membership among the surgical services.
Hypothesis 15: The total score for education of patients and family members varies as a function of group membership among the surgical services.

Table 61 depicts the results of the one-way ANOVA for Hypothesis 11 which stated that "the total score for satisfaction varies among the groups of surgical services." The analysis resulted in a statistically significant F ratio of 15.3746 which was notable at level 0.0001 ($F_{4,159} = 15.37$, $p < 0.0001$). The null hypothesis was

rejected. The total score for satisfaction as measured by the Forbes-Brown instrument varies among the surgical services.

TABLE 61

ANOVA TABLE REPORTING TEST RESULTS FOR HYPOTHESIS 11

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	4	5262.8899	1315.7225	15.3746	.0000
Within	159	13606.8358	85.5776		
Total	163	18869.7256			

Tukey's HSD post hoc test indicated significant differences between the ophthalmology service and orthopedic surgery, the ophthalmology service and general surgery, otorhinolaryngology and orthopedic surgery, and otorhinolaryngology and general surgery. The results are listed in Table 62.

TABLE 62

TOTAL SATISFACTION BY SERVICE
INDEPENDENT SAMPLES *t* TESTS OF THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	t	p<=
Ophthalmology	22.51	4.89	Orthopedic Surgery	31.9	11.63	4.87	0.001
Ophthalmology	22.51	4.89	General Surgery	37.37	10.91	8.07	0.001
Otorhinolaryngology	25.35	7.57	Orthopedic Surgery	31.9	11.63	2.82	0.006
Otorhinolaryngology	25.35	7.57	General Surgery	37.37	10.91	5.37	0.001

Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test in order to further examine mean differences between the two groups. The reported mean difference between ophthalmology and orthopedic surgery was significant at $t_{(82)} = 4.87$, $p < .001$. The reported mean difference between

ophthalmology and general surgery was significant at $t_{((79)} = 8.07$, $p < .001$. The reported mean difference between otorhinolaryngology and orthopedic surgery was significant at $t_{(73)} = 2.82$, $p = .006$. The reported mean difference between otorhinolaryngology and general surgery was significant at $t_{(70)} = 5.37$, $p < .001$.

Table 63 depicts the results of the one-way ANOVA for Hypothesis 12 which stated that "the total score for caring varies among the groups of surgical services." The analysis resulted in a statistically significant F ratio of 9.6 which was significant at level 0.0001 ($F_{4,159} = 9.6$, $p < .0001$). The null hypothesis was rejected. The total score for "caring" as measured by the Forbes-Brown instrument varies significantly among the surgical services.

Tukey's HSD post hoc test indicated significant differences between ophthalmology and orthopedic surgery, ophthalmology and general surgery, and otorhinolaryngology and general surgery. The results are reported in Table 64.

TABLE 63

ANOVA TABLE REPORTING TEST RESULTS FOR HYPOTHESIS 12

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	4	311.4518	77.8630	9.6005	.0000
Within	159	1289.5421	8.1103		
Total	163	1600.9939			

Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test in order to further examine mean differences between the two groups. The reported mean difference between ophthalmology and orthopedic surgery

was significant at $t_{(82)} = 4.14$, $p < .001$. The reported mean difference between ophthalmology and general surgery was significant at $t_{(79)} = 6.75$, $p < .001$. The reported mean difference between otorhinolaryngology and general surgery was significant at $t_{(69)} = 3.39$, $p = .001$.

TABLE 64

TOTAL CARING CONSTRUCT BY SERVICE
INDEPENDENT SAMPLES *t* TESTS OF THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	t	p<=
Opththalmology	6.74	1.6	Orthopedic Surgery	9	3.17	4.14	0.001
Opthalmology	6.74	1.6	General Surgery	10.53	3.25	6.75	0.001
Otorhinolaryngology	7.94	3.22	Orthopedic Surgery	9	3.17	1.43	0.158
Otorhinolaryngology	7.94	3.22	General Surgery	10.53	3.25	3.38	0.001

Table 65 depicts the results of the one-way ANOVA for Hypothesis 13 which stated that "the total score for competence varies among the groups of surgical services." The analysis resulted in a statistically significant F ratio of 17.03 which was notable at level 0.0001 ($F_{4,159} = 17.025$, $p < 0.0001$). The null hypothesis was rejected. The total score for "competence" as measured by the Forbes-Brown instrument varies among the surgical services.

TABLE 65

ANOVA TABLE REPORTING TEST RESULTS FOR HYPOTHESIS 13

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	4	444.7122	111.1781	17.025	.0000
Within	159	1038.3121	6.5303		
Total	163	1483.0244			

Tukey's HSD post hoc test indicated significant differences between the ophthalmology service and orthopedic surgery, the ophthalmology service and general surgery, otorhinolaryngology and orthopedic surgery, and otorhinolaryngology and general surgery. Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test in order to further examine mean differences between the two groups. The results are listed in Table 66.

TABLE 66

TOTAL COMPETENCE CONSTRUCT BY SERVICE
INDEPENDENT SAMPLES *t* TESTS OF THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	t	p<=
Ophthalmology	5.47	1.2	Orthopedic Surgery	8.17	3.16	5.23	0.001
Ophthalmology	5.47	1.2	General Surgery	7.21	2.41	8.28	0.001
Otorhinolaryngology	6.18	1.99	Orthopedic Surgery	8.17	3.16	3.19	0.002
Otorhinolaryngology	6.18	1.99	General Surgery	7.21	2.41	5.68	0.001

The reported mean difference between ophthalmology and orthopedic surgery was significant at $t_{(82)} = 5.23$, $p < .001$. The reported mean difference between ophthalmology and general surgery was significant at $t_{(79)} = 8.28$, $p < .001$. The reported mean difference between otorhinolaryngology and orthopedic surgery was significant at $t_{(73)} = 3.19$, $p = .002$. The reported mean difference between otorhinolaryngology and general surgery was significant at $t_{(70)} = 5.68$, $p < .001$.

Table 67 depicts the results of the one-way ANOVA for hypothesis 14 which stated that "the total score for continuity of care varies among the groups of surgical services." The analysis resulted in a statistically significant F ratio of 12.2 which was notable at level 0.0001 ($F_{4,159} = 12.201$, $p < .0001$). The null hypothesis was rejected.

The total score for "continuity of care" as measured by the Forbes-Brown instrument varies among the surgical services.

TABLE 67

ANOVA TABLE REPORTING TEST RESULTS FOR HYPOTHESIS 14

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	4	200.4463	50.1116	12.2010	.0000
Within	159	653.0415	4.1072		
Total	163	853.4878			

Tukey's HSD post hoc test indicated significant differences between the ophthalmology service orthopedic surgery, the ophthalmology service and general surgery, otorhinolaryngology and orthopedic surgery, and otorhinolaryngology and general surgery. Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test in order to further examine mean differences between the two groups. Table 68 provides the results of those tests.

The reported mean difference between ophthalmology and orthopedic surgery was significant at $t_{(82)} = 3.92$, $p < .001$. The reported mean difference between ophthalmology and general surgery was significant at $t_{(79)} = 6.84$, $p < .001$. The reported mean difference between otorhinolaryngology and orthopedic surgery was significant at $t_{(73)} = 2.99$, $p = .004$. The reported mean difference between otorhinolaryngology and general surgery was significant at $t_{(70)} = 5.51$, $p < .001$.

Table 69 depicts the results of the one-way ANOVA for Hypothesis 15 which stated that "the total score for education of patients and family members varies among

the groups of surgical services." The analysis resulted in a statistically significant F ratio of 13.9 which was notable at level 0.0001 ($F_{4,159} = 13.9048$, $p < .0001$). The null

TABLE 68

TOTAL CONTINUITY OF CARE BY SERVICE
INDEPENDENT SAMPLES *t* TESTS OF THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	*t*	p<=
Ophthalmology	4.44	1.05	Orthopedic Surgery	6.17	2.68	3.92	0.001
Ophthalmology	4.44	1.05	General Surgery	7.21	2.41	6.84	0.001
Otorhinolaryngology	4.68	1.25	Orthopedic Surgery	6.17	2.68	2.99	0.004
Otorhinolaryngology	4.68	1.25	General Surgery	7.21	2.41	5.51	0.001

hypothesis was rejected. The total score for "education of patients and family" as measured by the Forbes-Brown instrument varies among the surgical services.

TABLE 69

ANOVA TABLE REPORTING TEST RESULTS FOR HYPOTHESIS 15

Analysis of Variance					
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between	4	403.2296	100.8074	13.9048	.0000
Within	159	1152.7217	7.2498		
Total	163	1555.9512			

Tukey's HSD post hoc test indicated significant differences between the ophthalmology service and orthopedic surgery, the ophthalmology service and general surgery, otorhinolaryngology and orthopedic surgery, and otorhinolaryngology and general surgery. Independent samples *t* tests were conducted on the groups identified by Tukey's HSD test in order to further examine mean differences between the two groups. Table 70 lists the results of those tests.

TABLE 70

TOTAL EDUCATION CONSTRUCT BY SERVICE
INDEPENDENT SAMPLES *t* TESTS OF THOSE SERVICES
IDENTIFIED BY TUKEY'S HSD AS SIGNIFICANT AT LEVEL .05

SERVICE 1	MEAN	SD	SERVICE 2	MEAN	SD	*t*	p<=
Ophthalmology	5.86	1.64	Orthopedic Surgery	8.56	3.41	4.65	0.001
Ophthalmology	5.86	1.64	General Surgery	9.89	3.08	7.47	0.001
Otorhinolaryngology	6.56	2.13	Orthopedic Surgery	8.56	3.41	2.97	0.004
Otorhinolaryngology	6.56	2.13	General Surgery	9.89	3.08	5.28	0.001

The reported mean difference between ophthalmology and orthopedic surgery was significant at $t_{(82)} = 4.65$, $p < .001$. The reported mean difference between ophthalmology and general surgery was significant at $t_{(79)} = 7.47$, $p < .001$. The reported mean difference between otorhinolaryngology and orthopedic surgery was significant at $t_{(73)} = 2.97$, $p = .004$. The reported mean difference between otorhinolaryngology and general surgery was significant at $t_{(70)} = 5.28$, $p < .001$.

CHAPTER 4

DISCUSSION

The discussion and interpretation of the results outlined in Chapter 3 will follow the previously established sequence: 1) The Surgical Service Process, 2) Procedural Timing Variations, 3) Delays Occurring in the Operating Room, 4) Surgical Case Cancellations, and 5) Surgical Patient Satisfaction. The weaknesses of the study will also be discussed.

Discussion of The Surgical Service Process

The expected time of completing the surgical service process at Evans Army Community Hospital proved to be quite lengthy for routine surgical cases. The process takes nearly two months (54.76 days) to complete. Certainly patients can move completely through the process in a more expedient fashion. The timeline provided in the PERT analysis is generalized, based on the expert opinion of those who must navigate the surgical process on a regular basis. Furthermore, the surgical patients themselves play a part in determining the length of the process. Routine surgeries are scheduled at the time most convenient to the patient which may be months after their surgical consultation.

Potential inefficiencies exist throughout the process. Anecdotal information suggests that half the patients referred for surgical consultation by primary care physicians are unwarranted. If true, this certainly creates unnecessary backlog which then exacerbates the referral process creating longer waits.

The surgical clinic appointment and the administrative work associated with that appointment should be scrutinized further. Currently physicians conduct the bulk of the steps within those two activities. This may be handled by less specialized personnel.

The pre-admission clinic appointment allows nurses time to do a diagnostic work-up, laboratory and ancillary report evaluations, and patient education. Although this clinic possesses a remote laboratory, patients requiring an EKG must report to another location within the hospital. Furthermore, the pre-admission and same day surgery clinics must rely on printed operating room schedules for information on which patients are scheduled for surgery and when they are scheduled. This may prove confusing if cases are canceled or rescheduled due to unforeseen delays. Instant access to the operating room scheduling system simply is not shared with these two areas.

Discussion of Procedure Time Variations and Probabilities

Areas for this portion of the study include case lengths and probabilities, room turnover times, variations in procedure times, and operating room start times. Information stored in the Surgi-Server™ database was used at length for this portion of the study.

Discussion of Procedure Lengths and Probabilities

When examining procedure length probabilities, the two services most deserving of managerial scrutiny proved to be general surgery and orthopedic surgery. They both experienced similar rates of short and long procedures. The general surgery service experienced a probability of 0.35 that a particular case would run longer than 89 minutes. It is interesting that the general surgery service experienced 20 cases that ran longer than 300 minutes (.03 probability) compared to the orthopedic surgery service which experienced 2 extremely long cases (less than .01 probability). The orthopedic surgery service experienced a probability of 0.36 that a case would run long. Both services appear to consume approximately 2.84 hours of their surgical block time on longer cases. Longer cases are expected for these two services because of the types of procedures commonly performed by general and orthopedic surgeons.

Of urologic procedures, 22 percent were considered to be long cases and 2 of those cases ran longer than 300 minutes (.01 probability). Long cases within the urology service appear to expend approximately 1.76 hours of block time. Of the longer cases, 86.4 percent are completed within 90 to 179 minutes.

Ophthalmologic procedures largely fell under 89 minutes in length (.82 probability). Of the longer cases, nearly 90 percent fell within the range of 90 to 149 minutes which could account for 1.28 hours of scheduled block time per day. There were four outliers that consumed up to 269 minutes of block time. This may be attributed specifically to inexperienced surgeons.

Both the obstetrics and gynecology service and the podiatry service experienced probabilities of .83 that cases would run shorter than 89 minutes. The obstetrics and gynecology service, however, revealed a higher propensity for cases lasting less than 59 minutes (.65 probability). Both services tend to apply 1.36 hours of scheduled block time on longer cases. Of the two, only obstetrics and gynecology experienced cases longer than 180 minutes (.016 probability).

Certainly the one service with the highest propensity for shorter cases was otorhinolaryngology. Ninety percent of the surgical cases were under 89 minutes. Of the remainder, fully 8 percent of the cases fell within 90 to 179 minutes. This accounts for .64 hours of scheduled block time or 38 minutes.

These findings are not consistent with the surgical case time probability study conducted by Hackey et. al. (1984). Hackey et. al. concluded that nearly 75 percent of their total surgical caseload consumed 90 minutes or more. This simply is not the case at Evans Army Community Hospital. If anything, the converse is true; shorter cases tend to make up the bulk of the surgical caseload. This is more than likely due to several technological advances made since Hackey et. al. performed their probability study in 1984. For example, today, direct laparoscopic visualization techniques allow surgeons to perform a variety of procedures with minimal invasiveness. This advance has resulted in faster procedure times for a variety of surgical techniques. In addition, most of the patients seen at Evans Army Community Hospital are young and healthy. They simply do not require more complex and longer surgeries.

Although not as pertinent today as 12 years ago, managers still must consider procedure lengths and probabilities when scheduling block times. Hackey et. al. suggested a modified block process where longest cases first was the rule. Although surgical cases do not tend to run as long as they did a decade ago, this is still a worthy recommendation. Managers should continue to monitor case lengths as well as the probabilities associated with case lengths.

Discussion of Operating Room Turnover

Room turnover among the various surgical services ranged from mean times of 18 to 38.33 minutes. The services experiencing the fastest room turnover rates were dental, otorhinolaryngology, ophthalmology, podiatry and obstetrics and gynecology. They experienced turnover rates ranging from 18 minutes to nearly 23 minutes and accounted for 54 percent of the sample (391 cases). Longer room turnover rates were experienced by general surgery, urology and orthopedic surgery. These services experienced mean times ranging from 23.39 minutes to 24.01 minutes and accounted for 45 percent of the sample (331 cases). The oral surgery service experienced the longest room turnover times with a mean of 38.33 minutes but accounts for less than 1 percent of the sample (6 cases).

Hypothesis 1 which stated that "operating room turnover varies as a function of group membership among the surgical services" was proven to be statistically significant ($F_{8,722} = 4.59$, $p < .0001$). Turnover times for the otorhinolaryngology service were significantly faster than general surgery, orthopedic surgery and oral surgery. The room turnover time for the oral surgery service was significantly longer

than the services of ophthalmology, podiatry, obstetrics and gynecology and general surgery.

Hypothesis 2 which stated that "operating room turnover varies as a function of group membership among the operating rooms within the operating suite" was also statistically significant ($F_{6,724} = 4.14$, $p < .0001$). Operating room number 3 experienced the fastest mean turnover time at 18.94 minutes. When compared to the seven operational rooms, turnover of room number 3 was significantly faster than both rooms 2 and 4. This may be explained by the fact that the predominance of the caseload associated with room number 3 comes from the otorhinolaryngology service. Operating rooms 2 and 4, on the other hand, are blocked primarily to general surgery, orthopedic surgery and oral surgery.

Mazzei (1994) suggests that variation with operating room turnover exists between rooms and surgical services primarily because of the nature of the procedure. Ophthalmologic procedures often do not require floor washing between individual cases. This is also true for many cases conducted by both the otorhinolaryngology and podiatry services.

In a study conducted by Schanilec et. al. (1993), data pertaining to room turnover rates was collected from 29 separate facilities. Of the 29 facilities examined in the study, 23 were within hospital settings and 6 were within freestanding ambulatory surgical center settings. Table 71 only utilizes the hospital findings from Schanilec et. al. to allow for benchmark comparisons.

TABLE 71

BENCHMARK COMPARISON OF ROOM
TURNOVER TIMES ASSOCIATED WITH 23 OTHER HOSPITALS

SURGICAL SERVICE	ACTUAL	BENCHMARK	DELTA
General Surgery	23	29	-6
Orthopedic Surgery	24	34	-10
Ophthalmology	20	25	-5
Otorhinolaryngology	19	24	-5
Urology	23	24	-1
Obstetrics and Gynecology	23	27	-4
Oral Surgery	38	31	7
Podiatry	20	24	-4

When compared to the 23 other hospitals from the study conducted by Schanilec et. al., Evans Army Community Hospital appears to be turning rooms over faster than the benchmark in every service except oral surgery. The most dramatic comparison occurs with the orthopedic surgery service which appears to be able to complete a room turnover approximately 10 minutes faster than the national benchmark. The general surgery service is approximately 6 minutes faster than the national benchmark. Ophthalmology and otorinolaryngology are 5 minutes faster than the national benchmark. Obstetrics and gynecology and podiatry are 4 minutes faster while the urology service appears to be approximately 1 minute faster. Dental services were not studied by Schanilec et. al. and therefore not benchmarked. The oral surgery service at Evans Army Community Hospital fared poorly in the benchmark comparison. This service appears to execute room turnover a full 7 minutes slower than the national benchmark, however; only 6 oral surgery cases were reviewed by this researcher while Schanilec et. al. examined 30 cases.

Discussion of Procedure Time Variations

It was established earlier with procedure probability tables that the different services experience variation in procedure times. Managers and schedulers must be concerned only if the variation is significant, and then they should remain cognizant of that variance when allocating available blocks of operating time to those services. The goal is to always promote the optimal level of productivity. This can be hampered when certain services are allocated too little or too much block time than optimally required.

Hypothesis 3 which stated that "procedure times measured from the first incision to closing varies as a function of group membership among the surgical services" was proven to be statistically significant ($F_{8,3042} = 48.68$, $p < .0001$). Procedures performed by the otorhinolaryngology service are significantly shorter than all other services. Nearly every service experienced lower procedure times than general surgery and oral surgery.

Variation of procedure times are obviously due to the many types of procedures performed by the various services. Some procedures simply require more time to perform. It is not the intent of this study to recommend the adequate amount of time to allocate per procedure but to simply provide management with an idea of the measure of central tendencies associated with services when utilizing time in the operating room.

Other than variation in procedure times, managers should also remain cognizant of anesthesia times associated with each surgical service. Hypothesis 4

which stated that "anesthesia time measured from induction to extubation varies as a function of group membership among the surgical services" also proved to be statistically significant ($F_{8,3042} = 54.14$, $p < .0001$).

The findings for anesthesia times were consistent with procedure times. The otorhinolaryngology service which experienced the shortest procedure times subsequently use less operating room time with anesthesia delivery. In fact, otorhinolaryngology uses significantly less time in conjunction with anesthesia delivery than all other surgical services. Ophthalmology, obstetrics and gynecology, urology and podiatry utilize less time associated with anesthesia delivery than orthopedic surgery, general surgery and oral surgery. All surgical services at Evans Army Community Hospital utilize significantly less anesthesia time than the oral surgery service. This is not surprising considering that the oral surgery service typically expends more time per procedure than all of the other services. Furthermore, procedures that are performed close to the airway require more anesthesia time.

Of particular concern to operating suite managers is the amount of operating room time expended while not performing the actual surgical procedure (Delta Time). This time is often used to set up the room, prepare and position the patient, drape the patient and complete the anesthesia induction. Of all the procedural times associated with operating rooms, the Delta Time is perhaps the most influenced by managerial activities. Hypothesis 5 which stated that "the amount of elapsed time measured by the difference between the total room time and the procedure time (Delta Time) varies

as a function of group membership among the surgical services" proved to be statistically significant as well ($F_{8,3042} = 54.14$, $p < .0001$).

Once again, the otorhinolaryngology service stood out. Otorhinolaryngology experienced a shorter mean Delta Time (39.5 minutes) than all other services. This difference was significant when compared to podiatry, obstetrics and gynecology, urology, general surgery, orthopedic surgery and oral surgery. The ophthalmology service experienced similar differences when compared to the other services which is not surprising. One could argue that both otorhinolaryngology and ophthalmology perform easier and more routine procedures than the other services. The podiatry service also experienced significantly shorter Delta Times when compared to general surgery, orthopedic surgery and oral surgery. Once again, the oral surgery service expended more time than all other services.

Discussion of Operating Room Starts

Of the 499 surgical cases reviewed in order to examine nursing starts, 379 cases started later than scheduled. The elapsed time for these cases ranged from 3 minutes to 450 minutes. Of the 379 cases considered as late starts, 152 cases (40 percent of the late cases) fell within 30 minutes of their scheduled start which may be considered as acceptable from a management perspective. An additional 159 cases (42 percent of the late cases) fell within the range of 31 minutes to 60 minutes of their scheduled start. These cases should provide cause for alarm and trigger some type of improvement study. The remaining 8 percent of the late starts fell within a range of 65 minutes to 450 minutes. Certainly this last category merits further scrutiny as well,

however, there are many reasons for such extreme discrepancies. For instance, if an emergency case enters the schedule at the last minute, very little can be done to prevent such drastic late starts.

Hypothesis 6 which stated that "the actual rate of late starts occurring in the operating room varies significantly from the expected rate among the surgical services" was found to be insignificant (X^2 = 12.45, df = 8 , p = .132). There does not appear to be a significant relationship between the rate of late nursing starts and membership among the surgical services. Actual rates of late occurrences were only slightly different than the expected rates, and the null hypothesis was therefore accepted.

Services experiencing slightly higher rates of late nursing starts than expected included orthopedic surgery (0.3 cases higher), otorhinolaryngology (2.6 cases higher), urology (2.5 cases higher), obstetrics and gynecology (4.6 cases higher), oral surgery (2.1 cases higher) and dental services (0.2 cases higher). Services experiencing slightly lower rates of late nursing starts than expected included ophthalmology (2.3 cases lower) and podiatry (4.5 cases lower).

Hypothesis 7 which stated that "the actual rate of late starts occurring in the operating room varies significantly from the expected rate among individual operating rooms" was found to be even less significant (X^2 = 1.63, df = 6, p = .95). In this instance, there was even less variation among the actual and expected scores. There appears to be no relationship between the rate of late nursing starts and room assignments. The null hypothesis was accepted in this instance.

A completely different sample was used to examine physician start times than was used to examine nursing starts. The same convenience sample used to produce procedure probability tables and measure procedure lengths was also used to measure physician starts. Nine cases from this sample were deleted because Patient In scores were left vacant. The mean "To Procedure" times ranged from 19.26 minutes (otorhinolaryngology) to 37.99 minutes (orthopedic surgery). This is not too surprising. Orthopedic patients require complicated positioning before surgery, and surgeons usually require more equipment to be in place.

Nearly 60 percent of the reviewed cases (1,808 cases) resulted in a first incision within 30 minutes after the patient entered the room. First incisions occurred from 31 to 60 minutes after the patient initially arrived in the room in 35 percent (1,067 cases) of the cases reviewed. Nearly 95 percent of all cases reviewed experienced first incisions within 60 minutes after the patient entered the room.

First incisions occurred faster within otorhinolaryngology, podiatry and ophthalmology. All three services resulted in mean To Procedure times that were well under 30 minutes. Urology, dental services and obstetrics and gynecology experienced means within 30 to 32 minutes. The greatest amount of elapsed time resulting from when the patient enters the operating room until the first incision occurred among orthopedic surgery, oral surgery and general surgery. Their mean times ranged from 34 minutes to 38 minutes after the patient entered the room.

Hypothesis 8 which stated that "the duration between the time a patient arrives in the room and the time of the first incision varies as a function of group membership

among the surgical services" was proven to be statistically significant ($F = 43.2$, $p < .0001$). Substantial variation of To Procedure times exists among the surgical services. First incisions occurred significantly faster within otorhinolaryngology when compared to podiatry, ophthalmology, urology, dental services, obstetrics and gynecology, general surgery, oral surgery and orthopedic surgery. The same is true when comparing podiatry and ophthalmology to urology, obstetrics and gynecology, general surgery, oral surgery and orthopedic surgery. Even services with somewhat lengthy To Procedure mean times like urology, obstetrics and gynecology and general surgery possess significantly faster incision times when compared to the slowest service, orthopedic surgery.

A study conducted by William Mazzei (1994) at a large university medical center revealed that the first surgical incision was made 21 to 49 minutes after the patient entered the operating room. This was largely due to the time required for anesthesia induction and surgical preparation and draping of the patient. Mazzei's results differ significantly from those reported here. Nearly 15 percent of the cases that were examined at Evans Army Community Hospital resulted in surgical starts of greater than 49 minutes after a patient entered a room. In fact, there were 434 cases from the sample that resulted in first incisions occurring from 50 to 212 minutes after the patient initially entered the operating room.

These results create perplexing question for managers. Why did so many cases result in such lengthy To Procedure times? Were there common root causes for these

long, drawn-out times? What can be done to prevent such protracted times in the future?

Discussion of the Delays Occurring in the Operating Room

The health care industry currently exists within an environment that demands efficiency and cost controls. For hospitals to survive, they must deliver quality services while controlling costs and inefficiencies. Certainly one of the most perplexing culprits within surgical services is case delays. How many times have frustrated surgeons complained about not being able to start a case on time because preceding cases ran too long?

An examination of 779 surgical cases through a direct observation method at Evans Army Community Hospital exposed a significant number of delays occurring within all services. Observed delays occurred in 17.5 percent of the cases resulting in a total of 155 delays which accounted for an estimated 2,575 wasted minutes. This is displayed in more detail in Table 72.

Of the total estimated time associated with delays occurring in the operating room, the general surgery and orthopedic surgery services accounted for nearly 50 percent (1,235 minutes) of the total. Approximately 40 percent of the time consumed by delays (965 minutes) were associated with the otorhinolaryngology, urology and obstetrics and gynecology services. The remaining services consumed 375 minutes or approximately 15 percent of the estimated time squandered by delays.

TABLE 72

OBSERVED DELAYS AND ESTIMATED DELAY TIME BY SERVICE

SURGICAL SERVICE	N	NUMBER OF DELAYS	TOTAL DELAY TIME	% OF TOTAL DELAY TIME	MEAN	SD
General Surgery	139	39	585	22.72%	4.21	9.51
Orthopedic Surgery	162	34	650	25.24%	4.01	11.05
Ophthalmology	42	11	125	4.85%	2.98	5.85
Otorhinolaryngology	144	17	320	12.43%	2.22	8.19
Urology	76	13	260	10.10%	3.42	11.56
Obstetrics/Gynecology	136	27	385	14.95%	2.83	7.79
Oral Surgery	11	3	95	3.69%	8.64	18.45
Dental Services	5	1	15	0.58%	3.00	6.71
Podiatry	64	10	140	5.44%	2.19	5.55
Totals:	779	155	2575	100.00%	N/A	N/A

Interestingly enough, the most frequent causes of delays within the operating room were also the most easily resolved from a managerial perspective. The unavailability of the surgeon was the most frequently observed delay with a total of 40 occurrences. The apparent lack of history and physical examination information appearing on the patient's chart caused 15 delays. The unavailability of the anesthesiologist or nurse anesthetist accounted for 11 delays. Management emphasis on just these three areas could dramatically reduce these types of delays.

Table 73 provides information pertaining to the amount of wasted time attributed to various types of delays. The unavailability of the surgeon accounted for nearly 30 percent of the wasted time (717 minutes). The lack of the history and physical examination annotation on the medical chart accounted for nearly 10 percent of the wasted time (250 minutes). The unavailability of routine equipment accounted for 7.4 percent of wasted time (190 minutes). In all, there were 14 separate delay

codes accounting for an hour or more of squandered time within the operating room during the observation period.

These finding are consistent with previous research. Robinson (1993) and Grudich (1991) both discovered that the most significant factor contributing to delays within the operating room was the late arrival of the surgeon. Grudich also concluded that anesthesiologists contributed to delays by not presenting on time for individual surgical cases. Neither Robinson nor Grudich found significant numbers of delays caused by lack of patient history or physical examination information. This implies that drastic improvements can be made in reducing the number of delays caused by insufficient (or absence of) history and physical exam information.

Many of the other observed delays also fell under domains easily controlled by the operating room supervisor or chief surgeon. The most difficult domain to administer revolved around the patient. For many of those delays, there simply is not an easy solution.

The initial concern of this researcher was that certain services lost more time due to delays than other services. The mean time consumed by delays among the 136 cases experiencing observed delays was 18.93 minutes with a standard deviation of 14.24 minutes. Delays ranged from 5 to 90 minutes. This concern was tested through Hypothesis 9 which stated that "the time consumed with delays occurring within the operating room varies as a function of group membership among the surgical services." The one-way ANOVA yielded insignificant results ($F_{8,770} = 1.14$, $p = 0.333$). Existing variation of time consumed by delays among the surgical services

TABLE 73

DELAYS IN MINUTES DELINEATED BY INDIVIDUAL CODES

CODE	DELAY TYPE	MINUTES
1	Add-on Case	15
2	Case postponed/canceled	60
4	Delay from patient care unit	88
6	Order of cases rearranged	60
7	OR being cleaned, set up	65
8	Additional equipment needed	80
9	Additional instruments needed	12
10	Additional supplies needed	65
11	Additional equipment not available	20
12	Additional instruments not available	75
16	Equipment not functioning	27
17	Instruments not functioning	15
21	Routine equipment not available	190
22	Routine instruments not available	35
23	Routine supplies not available	10
24	Anesthesia not available/ready	108
26	Housekeeping not available	5
27	OR nurse not available	20
28	Surgeon not available	717
29	X-ray not available	23
30	OR tech not available	43
32	Additional x-rays needed	80
33	Anesthesia assessment not completed/recorded	10
36	Consent not signed	40
38	History and physical examination not on chart	250
41	Test results not on chart	15
43	Additional IVs, monitoring lines needed	30
44	Additional procedures performed	15
45	Difficult intubation	30
46	Difficult IV access	35
47	Failed regional technique	55
49	Patient not available	110
50	Patient being repositioned	25
51	Patient's condition	107
52	Difficult regional technique	40
	TOTAL:	2575

appears to be coincidental.

The second concern revolved around the rate of delay occurrences. Do certain services experience higher rates of delays? This was tested by Hypothesis 10 which stated that "the actual rate of case delay occurrences within the operating rooms varies significantly from the expected rate among the surgical services." Hypothesis 10 proved to be a more valid issue ($X^2 = 17.15$, df = 8, p = .03). Services experiencing more delays than the expected rate of 17.5 percent were general surgery, orthopedic surgery, ophthalmology and oral surgery. Services experiencing the expected number of delays or less were otorhinolaryngology, urology, obstetrics and gynecology, dental services and podiatry.

The general surgery service experienced the most significant excess with 10 more delays than expected. Ophthalmology experienced 4 more than expected. Orthopedic surgery experienced 3 more than expected, and oral surgery experienced only 1 more than expected.

Of the services experiencing fewer delays than the expected rate, otorhinolaryngology was the most significant with 12 fewer. Obstetrics and gynecology experienced 3 fewer, urology experienced 2 fewer, and podiatry experienced 1 fewer than the expected rate. Dental services experienced the expected number of delays.

Discussion of Surgical Case Cancellations

Another factor contributing to inefficiencies within hospital surgical service lines is the cancellation of elective surgeries. This can prove to be extremely

destructive and costly. At best, managers must devote time to rearrange multiple cases and schedules. At worst, the operating room and its staff must remain idle during peak surgical hours. Regardless, cancellations are detrimental to the organization.

At Evans Army Community Hospital, surgical cancellations occurred primarily due to patient factors (102 cancellations) and surgeon factors (62 cancellations) within the observed sample. The most frequent patient factors contributing to case cancellations included the patient presenting the day of surgery with a minor illness (47 cancellations), the patient changing their mind about undergoing surgery (29 cancellations), and patients simply not showing up for surgery on the scheduled day (10 cancellations). The most repeated surgeon factors included the surgeon ordering an additional evaluation to explain certain medical problems (20 cancellations) and the unavailability of the surgeon on the day of surgery (17 cancellations).

In all fairness, surgeon unavailability at Evans Army Community Hospital was primarily due to unforeseen deployments occurring in April 1996 which accounted for 12 cancellations. The remaining causes involved surgeons who were too ill to perform surgery. Also uncontrollable are the cases canceled due to the need for further evaluation. A surgeon simply has no choice but order further medical evaluation when acute changes in a patient's cardiac or pulmonary status occur.

Many of the cancellations occurring at Evans Army Community Hospital, however, are within management's sphere of influence. Cancellations resulting due to clerical errors, unknown reasons, overbooking, unavailable equipment, patient

reconsideration/no shows, and patient's not following pre-operative instructions can all be effectively reduced through increased managerial scrutiny.

The surgical case cancellations experienced at Evans Army Community Hospital are consistent with research conducted by Lacqua and Evans (1994), Hand et. al. (1990) and Knight (1987). All three efforts found that surgical case cancellations occurred primarily because of either patient or surgeon factors. This study is most consistent with that of Lacqua and Evans who found that patient factors contributed to 37 percent of surgical case cancellations and surgeon factors contributed to 20 percent of case cancellations at a large teaching hospital.

Discussion of Patient Satisfaction Findings

Patient satisfaction is becoming even more critical as the MHSS shifts toward a managed care environment. Military hospitals that are unable or unwilling to take measures to improve satisfaction run the risk of losing eligible beneficiaries to other managed care options. Strong anecdotal evidence exists which shows that dissatisfied patients are more inclined to talk about their negative experiences rather than their positive ones. Furthermore, patient recommendations may in fact influence other beneficiaries (Strasser and Davis 1991).

Patient satisfaction with surgical services at Evans Army Community Hospital appears to be high in the aggregate, however; statistically significant variation exists among services. Respondents tended to be more satisfied throughout the study with services provided by ophthalmology and otorhinolaryngology, and less satisfied with services provided by general surgery and orthopedic surgery.

Total satisfaction as measured by the Forbes-Brown instrument, varies considerably among the above mentioned services ($F_{4,159} = 15.37$, $p < .0001$). Respondents from the ophthalmology and otorhinolaryngology services consistently reported significantly higher levels of satisfaction than those of general surgery and orthopedic surgery.

These finding were consistent when measuring patient perceptions regarding the interpersonal interactions occurring between themselves and their providers (the caring construct). Statistically significant variation existed among the services ($F_{4,159} = 9.6$, $p < .0001$), however; comparisons between otorhinolaryngology and orthopedic surgery were insignificant ($p = .158$) in this one instance. Once again, patients responding from the ophthalmology and otorhinolaryngology services appeared significantly more satisfied with the amount of compassion and concern shown by the nurses and physicians within those services and support staff. Patients appeared to be significantly less satisfied with the amount of caring and concern demonstrated by the general surgery and orthopedic surgery services.

Significant variation existed as well when measuring perceptions of provider competence among the services ($F_{4,159} = 17.025$, $p < .0001$). Respondents from the ophthalmology and otorhinolaryngology services once again perceived higher levels of competence among their providers than did respondents from the general surgery and orthopedic surgery services.

When measuring patient perceptions on how well their care was coordinated, once again the ophthalmology and otorhinolaryngology services stood out.

Respondents rated those services significantly higher than the others ($F_{4,159} = 12.2$, $p < .0001$). General surgical and orthopedic patients reported lesser satisfaction with the effectiveness and consistency of their care.

Respondents from the ophthalmology and otorhinolaryngology services reported higher levels of preoperative and postoperative information provided to them as well. Their perceptions of patient and family education occurring during the surgical process varied significantly among services ($F_{4,159} = 13.9$, $p < .0001$) as well. Their scores were significantly higher than those reported in the general surgery and orthopedic surgery services.

As mentioned before, responses viewed in the aggregate seem to suggest high levels of satisfaction among those patients who were surveyed. This includes both the general surgery and orthopedic surgery services. After viewing the findings, it is apparent that general surgical and orthopedic respondents appear satisfied with the services they received. One must wonder, however, about the significant variation which exists. Although patients overall show high levels of satisfaction, why do two services show significantly higher levels of satisfaction? What are those services doing differently than the other two? How can services improve patient perceptions regarding the level of care received?

Weaknesses of the Study

Convenience samples were utilized throughout the study; therefore, generalization of the study findings to other populations must be made with the appropriate caution. Furthermore, samples used for the study were not representative

of the population data from DMIS. Retirees and their family members represented larger percentages of the study sample than reflected in the eligible beneficiary population.

The sample used to examine operating room turnover was limited to "clusters" of surgical cases and did not include all of the cases performed during the day. The purpose for analyzing clusters was to provide more realistic information pertaining to room turnover; however, the study fails to thoroughly review problems associated with long breaks between cases.

The method for collecting information pertaining to delays occurring in the operating room relied heavily upon independent observations. Although a great deal of care was taken initially to discuss each delay code and the limits of their participation, the circulating nurses acting as observers may have interpreted various delay situations differently. Some may have been more active than others at recording their observations.

The methodology for distributing the Forbes-Brown instrument was not optimal. By not mailing the instrument, there was no real process for determining declination rates among the respondents. Furthermore, patients may have felt pressured to complete the survey within the clinic setting despite the instructions stating that participation among respondents was purely voluntary. The retrospective nature associated with survey instruments rely heavily on the memories of the respondents and should be interpreted carefully. The fact that patients completing the Forbes-Brown instrument were presenting for post-surgical follow-up appointments

allow for better recall; however, a "honeymoon effect" attributed to the short amount of time between the procedure and the survey may account for the high level of reported satisfaction.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Several indicators such as low utilization rates of scheduled block surgical hours and steady surgical cancellation rates suggested to the organization's leadership that various inefficiencies existed within the surgical service line at Evans Army Community Hospital. A review of the literature provided several methodologies to examine a variety of indicators common to surgical service management. The purpose of this study was to examine those indicators using tools from previous research, draw conclusions based on the examination and provide recommendations to the hospital leadership.

The Surgical Service Process: Conclusions and Recommendations

Moving patients through the surgical service process is complicated. Multiple disciplines must coordinate efforts to make this very difficult process work efficiently. After examining the process and interviewing several key personnel who maneuver regularly through the process, it is apparent that Evans Army Community Hospital performs very well in its role of providing surgical services. The professionals who make up the medical, nursing and ancillary staffs are extremely dedicated to performing their jobs as well as possible; however, certain inefficiencies do exist. No

process is perfect. Improvements can always be made, and professionals should aggressively pursue opportunities to make those improvements. Identified inefficiencies exist within the referral process, the clinical administration process and within the pre-admission process.

An interesting issue regarding the referral process arose during this researcher's interview with the chief of the general surgery service, Dr. Hotard. According to Dr. Hotard, approximately 50 percent of the patients whom he sees on referrals are unnecessarily or inappropriately referred. If this problem is widespread across the surgical clinics, then efforts should be made to correct it. Operating room utilization rates are linked with demand for surgical services. If the demand cannot be efficiently identified, how can utilization rates be improved? One recommendation is to provide a series of professional inservices conducted by various surgical specialists on appropriate ways to recognize cases requiring certain surgical interventions. This will serve two purposes. First, it will fulfill continuing medical education requirements within the organization. Second, it will assist in improving the referral process to the surgical clinics if successfully implemented.

Inefficiencies within the surgical appointment activity are minimal but still costly. Currently surgeons spend a great deal of the appointment period compiling the patient's history and performing a physical examination. If the patient is identified as a surgical candidate, the surgeon then is required to gain informed consent before scheduling the procedure. If physician extenders were available to perform these functions, the surgeon could be freed to perform further clinical evaluations elsewhere.

In effect, he or she could continue to diagnose and determine appropriate surgical interventions with other scheduled patients. A physician assistant could very easily perform the necessary physical examinations as well as receive patient histories. This proposal may be explored further after the implementation of Tricare. Once the contractor is named for Region 8, various surgical services may choose to submit resource sharing proposals seeking extenders instead of additional physician manpower which is several times more costly. Once employed in various clinics, extenders could prove instrumental in increasing surgeon productivity during the clinic days.

Issues existing within the pre-admission clinic include the apparent lack of access to the operating room's scheduling system, Surgi-Server™, as well as the absence of an EKG. Currently patients who present to the pre-admission clinic who require an EKG must go elsewhere in the hospital to fulfill that prerequisite. This burdens patients with additional hospital appointments requiring more of their time. Organizations need to be mindful of the fact that many preoperative patients undergo a great deal of anxiety and stress. Anything that the organization can possibly do to relieve them of that cumbersome weight is a worthwhile endeavor.

The recommendation is simply to procure the necessary equipment to operate an EKG service within the confines of the pre-admission clinic. A remote laboratory with limited capability already exists there. This addition should complement the clinic's services nicely.

Furthermore, the staff at the pre-admission clinic currently do not have access to Surgi-Server™ for current scheduling information. They conduct day-to-day operations in a relative void of pertinent information. Access to the scheduling system will allow for easier decision making to occur among the pre-admission clinic staff members. As in most industries, information within a hospital environment is an extremely valuable resource. The capability to share the required information is available, and the pre-admission clinic staff certainly have a "need to know" requirement that does not violate patient confidentiality.

The recommendation is to purchase the necessary license (not necessarily the software) to load a "limited" version of Surgi-Server™ within the pre-admission clinic. Certainly pre-admission staff members should not have the capability to make scheduling changes or any other changes in the surgical schedule. A "read only" version would satisfy their informational needs. The scheduler would have to update the database as soon as changes occur in order to provide more meaningful and timely information.

Procedure Time Variations and Probabilities

Indicators examined in this area included case length probabilities, room turnover times, variations in procedure times, and operating room start times. Each indicator will be reviewed individually.

Procedure Lengths and Probabilities: Conclusions and Recommendations

The predominance of the surgical cases performed at Evans Army Community Hospital are short cases (requiring 89 minutes or less from incision to close). The purpose for examining case length probabilities in this study was to aid managers in determining the overall best scheduling policy to adopt. There are incredibly high costs associated with equipping, maintaining, and staffing an operating room. Efficient use of the facility is critical. Currently a blocking policy is used by the surgical staff. Much of the literature supports the use of such a policy if organizationally possible, however; there also exists a preponderance of studies supporting a longest-cases-first policy (Goldman et. al. 1969, Hackey et. al. 1984, Breslawski and Hamilton 1991, Hamilton and Breslawski 1994).

After thoroughly examining the surgical service line, the recommendation from this study is to adopt a modified blocking system that incorporates the longest-cases-first system as well. Service blocks should be divided according to the probability of that particular service experiencing a "long" case. The probability tables should allow managers an opportunity to determine an appropriate amount of time to dedicate for those cases. Ideally, such a policy will increase utilization rates by maximizing the amount of prime surgical time spent in each room. Shorter cases tend to require more time to set up and clean rooms as well as transport and prepare the patients for surgery. Moving the shorter cases to the latter portion of the block will ensure maximal use of the room.

Operating Room Turnover: Conclusions and Recommendations

There does not appear to be a problem with room turnover at Evans Army Community Hospital. In fact, the services are performing better than the available benchmark data associated with room turnover. The oral surgery service appears to experience exceptionally long times associated with turning over their rooms but accounts for less than 2 percent of all surgical cases performed. Should organizational resources be utilized to correct this shortcoming? Management must make that decision.

After reviewing the data, the recommendation is to periodically review turnover rates and continue to compare the data to existing benchmark information. Currently the organization is performing this task extremely well. No other initiatives appear to be necessary.

Procedure Time Variations: Conclusions and Recommendations

For this particular study, procedure time variations included procedure times, anesthesia times and nonoperating time (Delta Time). The purpose for examining variation in these areas was to provide managers with additional information besides the case length probabilities to better enable them to determine appropriate block allocations. Significant variation exists among the services in all three areas.

Currently, there are 192 available block hours in existence at Evans Army

TABLE 74

BLOCK HOURS/UTILIZATION RATES BY SERVICE

SURGICAL SERVICE	BLOCK HOURS	% BLOCK HOURS	% UTILIZATION
General Surgery	40	20.83%	54.82%
Orthopedic Surgery	56	29.17%	46.93%
Ophthalmology	16	8.33%	36.13%
Otorhinolaryngology	24	12.50%	46.47%
Urology	16	8.33%	56.52%
Obstetrics/Gynecology	24	12.50%	53.02%
Oral Surgery/Dental	8	4.17%	40.50%
Podiatry	8	4.17%	30.26%
Totals:	192	100.00%	N/A

Community Hospital per each five-day work week which are apportioned according to Table 74. The utilization rates shown in Table 74 reflect historic rates calculated for May 1995 through September 1995. The question that surgical service managers must ask is whether the current allocation optimally supports the organization?

If the eventual goal of the surgical service management is to reallocate blocks to maximize utilization, this information can serve as a tool to aid their decision making process. The recommendation when allocating limited resources is to utilize linear programming, a mathematical technique used to determine, in this case, the optimal allotment of block time. Ideally, a multidisciplinary team made up of representatives from all of the surgical services, anesthesia, and the operating room should be formed to discuss appropriate allocations of prime surgical time. The goal, or objective function of the linear program, would simply be to maximize utilization of available surgical time through optimal allocation of available block time to the surgical services. Variables of interest would include the historic utilization rates of each service, the backlog of surgical cases by service, the availability of surgeons, and

the operating room staffing. Constraints to the schedule must also be discussed. For instance, a particular service may require a set amount of block time regardless of utilization patterns. Certainly no service should receive zero block time as part of the linear solution. Other constraints include the availability of operating rooms which, of course, is dependent upon staffing. Once the basic variables and constraints have been identified and agreed upon by the team, the program can be written. There are numerous, inexpensive, software programs which facilitate linear programming. The spreadsheet package common at Evans Army Community Hospital, Microsoft Excel, also solves (or optimizes) linear problems. The solution can then be implemented into a modified block/longest-cases-first scheduling policy.

Operating Room Starts: Conclusions and Recommendations

Operating room starts were analyzed from the "nursing" perspective as well as the "physician" perspective. The surgical process from a nursing viewpoint begins when the patient enters the room. The goal is to ensure that the patient enters at the scheduled time so as not to cause further delay. Surgeons view the surgical start as the time of the first incision. Regardless of how starts are defined, this area appears to be problematic within the surgical service line.

Only 24 percent of the cases examined for nursing starts actually started on time. Of the cases identified as late, 40 percent fell within an acceptable 30 minute range from the scheduled start. Still, nearly 46 percent of the entire sample fell outside of that acceptable range. Although the problem is widespread, no particular service experiences a significantly higher rate than another ($p = .132$).

Certainly one of the weaknesses in the study of nursing starts is the fact that there were no causal connections collected in the form of data to account for the late starts. The recommendation to correct the problem of late nursing starts would have to involve additional research with a performance improvement focus. A 46 percent rate of late starts in excess of 30 minutes is entirely inappropriate but offers a rich environment for the employment of improvement techniques. Operating room nurses would have to develop a data collection process that would incorporate codes associated with causes for late starts. Once the data was collected and analyzed, the nurses would be more capable of solving the problem by going through the performance improvement process. Control charts to monitor acceptable levels of late starts on a monthly basis are also recommended. This is a problem that requires continuous monitoring and evaluation to contain.

It is considerably more difficult to classify the statistically significant variation of physician start times (To Procedure Time) as a problem. Clearly certain surgical services require more time to prepare, position and drape patients for surgery. Certain services require more time to properly induce anesthesia. Therefore, it is unfair to classify the rampant variation as problematic. It does, however, merit further inquiry. Of particular concern should be the 434 cases resulting in physician starts 50 to 212 minutes after the patient initially entered the room. This is especially worrisome in light of the research conducted by Mazzei (1994) who determined that the predominance of physician starts should occur within 21 to 49 minutes after the patient enters the room.

If the surgical service line management at Evans Army Community Hospital considers physician starts a worthwhile endeavor for additional focus, the recommended action would be to simply place it on the agenda during one of the monthly performance improvement meetings. A roomful of surgeons are best qualified to address the issue of variation pertaining to physician starts as well as brainstorm on how to reduce those times considered overly excessive.

Delays Occurring in the Operating Room: Conclusions and Recommendations

Delays either in the form of late starts or delays occurring while actually in the operating room appear to be a chronic problem at Evans Army Community Hospital and elsewhere. Correcting this phenomenon will be extremely difficult because of the multiple causal factors involved as well as the involvement of a variety of professional disciplines interacting within the surgical process. Furthermore, certain delays are clearly unavoidable. Delays caused by difficult intubations or poor intravenous access go with the territory of providing surgical services, and there is no simple solution.

The recommended strategy to improve this issue must involve intergroup coordination and cooperation between the various professional groups. Lines of communication between all professional disciplines must remain open. The focus should be placed upon those causal factors most susceptible to managerial influence (personnel, equipment/supplies, environment). The Weimer data collection tool could easily be transformed into a cause-and-effect diagram. See Figure 6 for an example. Although no particular service tends to squander any more time due to delays than any

CAUSE AND EFFECT DIAGRAM: DELAYS IN THE OR

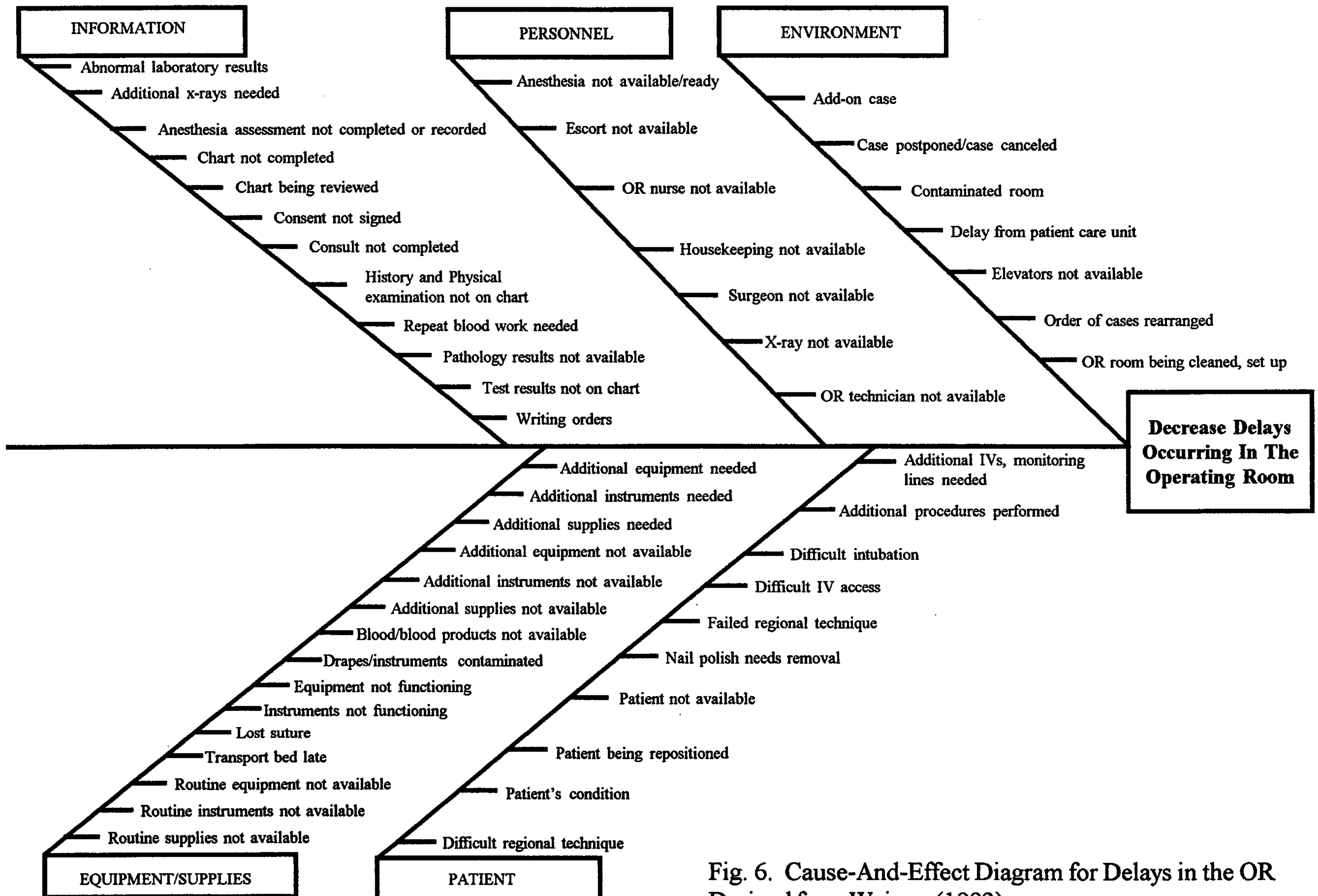

Fig. 6. Cause-And-Effect Diagram for Delays in the OR Derived from Weimer (1993)

other service ($p = .333$), certain services appear to experience more than the expected amount of delays ($p = .028$). Cooperation, therefore, is essential to any improvement initiative.

Services must agree upon the scheduled operating time. Essentially, there must be a common understanding between nurses, surgeons, and anesthesiologists about sentinel terms in the scheduling system. This requires a mutual awareness of when the patient *should* be enroute to the operating room suite, the time that the patient *should* be ready for the surgeon, and the time the first incision *should* occur. These times can be planned in advance and then placed on the daily operating room schedule.

Surgeons must play the pivotal role in this improvement process. For example, if additional supplies or equipment other than those identified as "routine" are needed for a particular case, the surgeon must ensure the operating room nurse is aware of the additional case requirements. Surgeons must be cognizant of impending delays and manage their cases accordingly.

Periodic assessments by nurses using the modified Weimer data collection tool should continue. The statistical analyses should include central measures of wasted time caused by delays within various delay constructs as well as individual services. Delay rates of occurrence should also be measured. The findings should be shared with everyone working in the operating room as well as the surgeons. Once goals are set, simple control charts can be utilized to focus on specific problem areas and trends to ensure that delays remain in check.

Surgical Case Cancellations: Conclusions and Recommendations

Surgical case cancellations have only recently come under close scrutiny at Evans Army Community Hospital. As operating room utilization became a significant management issue, cancellations quickly were regarded as one of the villains contributing to the problem of low utilization rates. Recommendations to improve cancellation rates include the following:

1. Increase interpersonal communication between the surgeon and patient during the preoperative phase especially in cases where consent may not be readily given or in cases that might result in patients changing their mind at the last minute. Reminder telephone calls before a scheduled procedure are also advisable in order to reduce patient "no show" rates.

2. Cancellations due to medical complications, a patient's illness or a need for further evaluations might be curbed through increased focus on cardiac symptoms and blood pressure during the physical exam. Once identified, a system of continuous monitoring may be developed for those patients deemed "high risk" for complications. Minor illnesses in children leading to cancellations will occur regardless.

3. Additional focus on preoperative education may decrease cancellations as well. Identifying patients who may experience difficulty complying with preoperative instructions and then tailoring preoperative instructions accordingly may also help.

Patient Satisfaction: Conclusions and Recommendations

Without question, satisfaction with the interpersonal aspects of medical care greatly impact a patient's overall satisfaction with the total hospital care received.

More and more, MTF commanders are becoming concerned with this phenomenon and rightly so. Tricare will greatly alter a beneficiary's ability to choose between competing health plans or options. An MTF's competitive ability will largely rest on patient satisfaction which should become a highly scrutinized metric for quality.

Patients at Evans Army Community Hospital are very satisfied with the care that they receive as indicated by the Forbes-Brown instrument; however, significant variation does exist among the surgical services. Those services experiencing significant negative variation in satisfaction scores should focus on ways to improve scores within the major constructs: caring, competence, continuity, and education. Because the instrument primarily focuses on the interpersonal relationship occurring between patient and provider, one strategy would be to alter provider behavior. By improving physician, nurse and ancillary staff conduct in those aspects of the process of care which are directly experienced by the patient, better scores could be gained on future survey efforts. Furthermore, it seems plausible that changes in office manner or practice styles could be accomplished with very little increase to hospital costs.

The Forbes-Brown instrument is designed to measure patients' opinions of the quality of hospital care they received. The recommendation of this study is to continue to periodically use the instrument in order to maintain a stream of information pertaining to patient satisfaction which may then be continuously monitored and trended. If the Forbes-Brown instrument does not sufficiently meet the organization's needs, then another instrument should be used in it's stead. One suggestion would be to utilize an instrument that includes constructs such as "access" and "structure" as

well as the various constructs focusing on the "process" of delivering care used in the Forbes-Brown instrument. Currently, hospital services use a variety of satisfaction questionnaires, some of which were designed independently by staff members. If survey efforts were uniform across all services, perhaps more useful information might be gathered.

The goals for continuous patient surveying should be to provide feedback which may then be used to monitor performance, identify trends more readily, assist in identifying areas of practice which might require restructuring, and to justify changes within the internal health care delivery system. Current attempts to survey patients appear to be haphazard. Certainly no uniform effort is being made in this area. Instead of utilizing a variety of instruments, choose one that has undergone scrutiny for reliability and validity.

Recommendations for Future Research

Surgical services offer many opportunities for further research with a managerial perspective. The following suggestions could very easily be launched from the platform of previous studies within the literature:

1. Because Evans Army Community Hospital does not archive the scheduled time allotted for each procedure, it was impossible to examine variation between the scheduled time and the actual time. Additional research should be conducted in this area. Are procedures actually conducted within the projected time? Are the rooms being underbooked? Overbooked?

2. Additional research should also focus on the validity of patient referrals to surgical clinics. The information presented in this study was purely anecdotal without supporting data.

3. One area ripe for future study involves productivity within the operating room. One can simply scrutinize workload associated with the operating room and measure the FTEs used to perform the workload. Is the current manpower appropriate for the current demand for surgical services?

4. When measuring satisfaction, one could also question internal customers. How well does the operating room serve the staff physicians? Certainly this area could lead to many suggestions for process improvement. Furthermore, elapsed time from surgery to survey can be determined and covaried out in the final analysis to remove the possibility of the "honeymoon effects."

APPENDIX 1

OPERATION REQUEST AND WORKSHEET

For use of this form, see AR 40-407; the proponent agency is the Office of The Surgeon General

SECTION A — REQUEST FOR SURGERY

1. PATIENT'S NAME *(Last, First, MI)* *(Print)*	2. STATUS	3. AGE	4. RELIGION	5. REGISTER NO	6. SSN *(with Family Member Prefix)*

7. PREOPERATIVE DIAGNOSIS	8. NURSING UNIT *(from - to)*

9. OPERATION PROPOSED	10. REQUESTING SERVICE

11. DATE OF SURGERY	12. TIME OR CASE NO	13. SCHEDULE PRIORITY *(check one)* ☐ EMERGENCY ☐ SEMI-EMERGENCY ☐ ROUTINE	14. BLOOD REQUIRED *(Unit)* cc	15. SEPTIC

16. SURGEON	17. ASSISTANT(S)	18. POSITION OF PNT	19. PREP REQUIRED

20. NURSING STAFF	21. ANESTHETIST(S)	22. ANESTHESIA

23. SPECIAL INSTRUCTIONS AND REMARKS

24. REQUESTING OFFICER *(Printed Name and Signature)*

SECTION B — OPERATION WORKSHEET

25. OPERATING ROOM NO	26. TIME OR CASE NO	27. SEPTIC	28. FLUIDS *(other than blood)*	29. BLOOD ADMINISTERED

30. SURGEON	31. ASSISTANT(S)	32. ANESTHETIST(S)	33. ANESTHESIA TIME *(Began and Ended)*

34. INDUCTION ANESTHETIC	AGENT	TECHNIQUE	37. AIRWAY	39. SPECIAL PROCEDURES *(Anesthesia)*
35. PRIMARY ANESTHETIC	AGENT	TECHNIQUE	38. RELAXANTS INTUBATION / OTHER	
36. SECONDARY ANESTHETIC	AGENT	TECHNIQUE		

40. NURSING TIME *(Began and Ended)*	41. SCRUBBED PERSON(S)	42. CIRCULATING PERSON(S)

43. OPERATION DATE	44. OPERATION TIME *(Began and Ended)*	45. DRAINS	46. SPONGE COUNT	47. LABORATORY SPECIMEN

48. OPERATIVE DIAGNOSIS

49. OPERATION(S) PERFORMED

☐ EPISODES OF SURGERY

50. COMPLICATIONS *(Continue on reverse, if more space is required)*

51. DICTATOR'S NAME, SERVICE & PHONE EXT	RECORDED IN REGISTER *(Initials)*

DA FORM 4107 MAR 82 EDITION OF 1 JUN 73 MAY BE USED.

APPENDIX 2

DELAY FACTORS

Environment

Code #	Delay Factor
1EN	Add-on case
2EN	Case postponed\Case cancelled
3EN	Contaminated room (ie. hepatitis, AIDS, etc.)
4EN	Delay from the patient care unit
5EN	Elevators not available
6EN	Order of cases rearranged
7EN	OR room being cleaned, set up

Equipment/Supplies

Code #	Delay Factor
1ES	Additional equipment needed
2ES	Additional instruments needed
3ES	Additional supplies needed
4ES	Additional equipment not available
5ES	Additional instruments not available
6ES	Additional supplies not available
7ES	Blood, blood products not available
8ES	Drapes/instruments contaminated
9ES	Equipment not functioning
10ES	Instruments not functioning
11ES	Lost suture
12ES	Transport bed late
13ES	Transport oxygen, ambu bag not available
14ES	Routine equipment not available
15ES	Routine instruments not available
16ES	Routine supplies not available

No Delay Occured

Code #	Delay Factor
0	No delay

Personnel

Code#	Delay Factor
1PE	Anesthesia not available\ready
2PE	Escort not available
3PE	Housekeeping not available
4PE	OR nurse not available
5PE	Surgeon not available
6PE	X-ray not available
7PE	OR tech not available

Information

Code #	Delay Factor
1I	Abnormal laboratory results
2I	Additional x-rays needed
3I	Anesthesia assessment not completed/recorded
4I	Chart not completed
5I	Chart being reviewed
6I	Consent not signed
7I	Consult not completed
8I	History and physical examination not on chart
9I	Repeat blood work needed
10I	Results from pathology not available
11I	Test results not on chart
12I	Writing orders

Patient

Code #	Delay Factor
1PT	Additional IVs, monitoring lines needed
2PT	Additional procedures performed
3PT	Difficult intubation
4PT	Difficult IV access
5PT	Failed regional technique
6PT	Nail polish needs removal
7PT	Patient not available
8PT	Patient being repositioned
9PT	Patient's condition
10PT	Difficult regional technique

Adapted from D.M. Weimer (June 1983)

APPENDIX 3

Surgical Patient Satisfaction Questionnaire

We at Evans Army Community Hospital are dedicated to continuous performance improvement, and we value your comments tremendously. Please take the time to complete and return this questionnaire. Check the appropriate block that best describes the nursing care you received during your hospital visit.

Please indicate the surgical service that you utilized.

❑ General Surgery
❑ Orthopedics
❑ Ophthalmology
❑ ENT
❑ OB/GYN
❑ Urology
❑ Oral Surgery
❑ Other ____________________

Please indicate your status.

❑ Active Duty
❑ Family Member of Active Duty
❑ Retiree
❑ Family Member of Retiree
❑ Survivor
❑ Other

Gender?

❑ Male ❑ Female

Age? ____________________

❑ Check here if Parent/Guardian responding for a minor.

1. I was treated with respect.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

2. My family was treated with respect.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

3. The nurses listened to me.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

4. The nurses met my needs without my asking.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

5. The nurses showed concern for my comfort.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

6. The nurses showed concern for the comfort of my family.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

7. I received information about each procedure <u>before</u> surgery.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

8. The nurses were confident in their abilities to provide care.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

9. I received information about each procedure <u>after</u> surgery.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

PLEASE TURN TO THE BACK OF THIS PAGE.

10. __Before__ surgery, the nurses explained to me what I needed to know.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

11. __After__ surgery, the nurses explained to me what I needed to know.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

12. My questions were answered by the nurses.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

13. I was prepared to care for myself because of the instructions I received.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

14. My family was included in the instructions I received.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

15. I understood each procedure as it was explained to me.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

16. My fears were reduced __before__ surgery due to the explanations given to me.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

17. The explanations given by the nurses decreased my fears __after__ the surgery.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

18. The nurses explained how I could relieve pain after I went home.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

19. My recovery after surgery was easier because of the instructions I received.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

20. The nurses asked if I understood the information given to me.

❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

21. List the most important concern that you had regarding the care that you received at Evans Army Community Hospital.

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22. If you return, how can we better meet your needs?

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23. What did you find most helpful during your visit?

Thank you for your input. Your comments are valuable to our staff. Please return this questionnaire to the clinic receptionist or appropriate nurse.

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